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National Fire Protection Association

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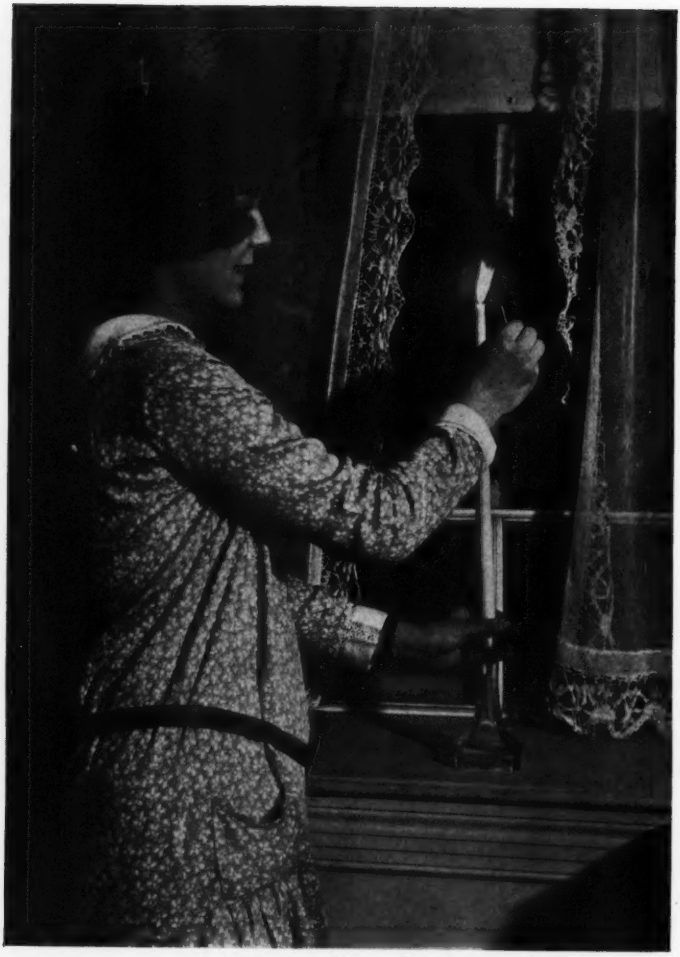


How Boston Tempts Moloch.

The Quarterly

Vol. 23 January, 1930 No. 3

The 1929 Fire Loss. The statistics of the fire loss for the year just closed as compiled by the New York *Journal of Commerce*, reported on another page of this QUARTERLY, represent an increase of about ten per cent over the losses of the year 1928. Some comfort may be taken, however, in the fact that the 1929 losses are materially lower than the annual totals recorded for the five-year period ending with 1926. Considering the general trend of the losses, rather than the figures for a single year, which are always subject to distortion by special influences, and keeping in mind the continuous increase in burnable values, the results should not be considered as discouraging.

In commenting on the 1927 losses, which showed an abrupt drop from 1926, the QUARTERLY said, "Fire prevention has not yet progressed to the point where we have any right to count on a continuing downward trend in fire losses . . . but the results obtained in individual cities which have taken fire prevention seriously point the way to the enormous reduction in our fire waste that may be anticipated when the country has become thoroughly imbued with the fire prevention idea."

Let us redouble our efforts in fire prevention during 1930!

* * * * *

Film Fires of 1929. The motion picture theatre fire in Paisley, Scotland, on the last day of 1929, in which seventy-two or more lives were lost, completes a most tragic record of death and destruction chargeable to nitrocellulose film during the year. The Paisley fire occurred too late to permit inclusion of a detailed report in this QUARTERLY, but if we may judge from the newspaper reports it was simply another case of improper arrangements for film projection, inadequate exits, and panic.

Starting with the Cleveland Clinic fire in May, there has been a veritable epidemic of serious fires involving nitrocellulose film. Some of these are recorded in this QUARTERLY; a number of others have not been covered because of space limitations and the difficulty of securing accurate reports. These fires reflect no new hazard. They perhaps merely represent the operation of the law of averages, compensating for a period of years when the hazard was ever present but during which few serious nitrocellulose film fires happened to occur.

No new lesson is involved. Nitrocellulose film is an extrahazardous material. This hazard can be amply safeguarded by the application of the safety measures long recommended by the National Fire Protection Association and all fire prevention authorities. A safe substitute, cellulose acetate film, is available for use wherever the complete safeguarding of the nitrate film is not practicable. Is it too much to hope that the tragic record of 1929 will shock the public into a full realization of the hazard of nitrocellulose film, with resultant application of the necessary fire-safety measures?

* * * * *

Conference on Spontaneous Ignition

The Conference on Spontaneous Heating and Ignition of Agricultural and Industrial Products mentioned in the October QUARTERLY (page 107) was held as scheduled in the Hotel Raleigh, Washington, D. C., on November 14 and 15, 1929. The program of this conference called by the N.F.P.A., in coöperation with the United States Departments of Agriculture and Commerce, was circulated to members with the November News Letter. The papers and discussion followed the program closely and brought out an immense volume of valuable and interesting material representing a major contribution towards the solution of this little understood fire cause.

The conference was attended by approximately one hundred and fifty men, including representatives of the various departments of the federal and state governments, industries interested in products subject to spontaneous ignition, insurance organizations, transportation interests and many other members of the Association representing various sections of the United States and Canada.

A complete report of this conference, incorporating the several papers presented and summaries of the stenographic record of the discussion, is being prepared by the United States Department of Agriculture and will be available later.

The final action of the conference was the adoption of a motion authorizing the executives of the N.F.P.A. to organize a Committee on Spontaneous Heating and Ignition to continue the work initiated by the conference, correlate research activities on the subject, and to serve as a clearing house for future work in this field.

* * * * *

A Stitch in Time.

While our great cities are already partially rebuilt of fire-resistive material and their conflagration hazards are being thus reduced with each passing year, the smaller cities, generally, offer fuel for sweeping fires, and many of them, in spite of extending fire-prevention education, may yet suffer such fire attack as to warrant appeal to their neighbors for assistance. When such fires occur, as, to cite examples, in Chelsea, Salem, and Fall River, the fire departments of neighboring cities

respond to calls for aid. On such occasions the plan and direction of their attack have heretofore been evolved, necessarily not with the highest wisdom, after their arrival amid the confusion and excitement of the fire. Many visiting crews in such circumstances have gone in on their own initiative, using their resources sometimes effectively, sometimes not, as their commanding officers, with limited knowledge of the local topography, might direct. Observation of these facts by our member, C. P. Faunce of Salem, brings from him a suggestion which the growing state and district organizations of fire chiefs might very profitably consider. This is to make their plans for fighting possible conflagrations before the conflagrations occur. Presumably the general direction of all departments participating in the fire attack should be the responsibility of the resident chief, but, unless a plan for utilizing and directing the neighbor departments in some systematic way has been previously evolved, confusion and lost motion will be inevitable. Certain far-sighted chiefs have no doubt already made some headway in conferences with their near neighbors on the subject of mutual aid; but it is a project which might very well be charted in a large and comprehensive way, considering the speed with which fire apparatus may now be driven, and the consequent helpful response of departments which in the old days were beyond the radius of reasonable coöperation. A general discussion of this matter by the fire chiefs at their various conventions might bring out valuable ideas of coöperative action, now the possession of the few fire fighters who have reflected upon it.

* * * * *

A Good Wetting. Water damage from the operation of automatic sprinklers seems often so to engage the attention of the public as to obscure the fact that without sprinklers the damage due to fire, not to mention that due to the use of fire department hose streams, would be many times greater. Fire stories written by newspaper reporters frequently serve further to befuddle the reader as to the facts of automatic sprinkler protection. The following report of a fire in Presque Isle, printed in the Bangor, Maine, *Commercial,* under the caption "Hedrich Store Gets Good Wetting," is a case in point.

Many residents were aroused and excited at 3:30 Monday morning by a fire alarm rung in from Box 16, which means a fire somewhere in the heart of the business section. It proved to be at the large business house of U. J. Hedrich, State Street. The fire company was on hand in a trice and work was begun. This large block is one of the several business houses equipped with a fire sprinkling apparatus, and under favorable conditions the fire would have been quenched quickly. But there seemed to be too much heat for the sprinklers and two of them burst, letting the water flow where it would, thus causing about a $10,000 damage. The fire started in a barrel which stood in one corner of the elevator, and the iron flooring overhead prevented the water flowing on the immediate fire. Not much damage was done by fire but almost entirely by water. But for timely discovery it would have been very destructive.

Newspaper reports written with a proper understanding of the fundamentals of fire prevention and fire protection can serve as a potent factor in public education and resultant decreased fire losses. N.F.P.A. members should neglect no opportunities to influence the more understanding treatment of accounts of fires in their daily newspapers.

* * * * *

Airplanes in Fire Fighting. The rapid development of aviation leads to questions as to the possible uses of airplanes in fire fighting operations. On several occasions during the past year fires have been discovered by passing pilots, who have given the alarm by circling around the burning building until the occupants were aroused. Planes have been used for some years on forest fire patrol service, and particularly in Canada for transporting men and equipment to fight forest fires in otherwise inaccessible regions.

If the airplane could carry some sort of fire equipment that could be effectively operated from the plane itself, fires might be attacked in their incipiency, thus eliminating the delays in the start of fire fighting operations which with present methods are unavoidable, particularly where fires start in places that can be reached only on foot. The difficulty, of course, is that in attempting to adapt existing fire fighting technique to airplane use the weight involved seems prohibitive.

In connection with an inquiry on this subject the Executive Office wrote to the U. S. Forest Service and received the following reply:

Suggestions have been received from time to time that forest fires may be extinguished or checked by the dropping from airplanes of bombs containing chemicals such as have at some time proved effective in city fires. The use of gas and chemicals in the World War suggested to many minds the idea that bombs of this character could be used effectively in fighting forest fires. This plan has been thoroughly investigated and found to be impracticable. The destructive effect of gas produced by bombs in warfare was in its poisoning or possibly killing a body of troops, whereas a fire cannot be poisoned but can only be smothered. The use of bombs in fighting fires requires that the fire be confined within walls, since the action of the gas generated depends largely upon the exclusion of oxygen. Forest fires, on the other hand, burn in the open. Frequently the front ranges from a few hundred feet to several miles in length, and a sufficient quantity of gas could not be used to have any appreciable effect. Furthermore, the severe fires are always accompanied by high winds, which would immediately dissipate the gas with practically no effect upon the fire. Unless a gas can be generated that has so heavy a specific gravity as not to be affected by the wind it can have no success in fighting fires out of doors.

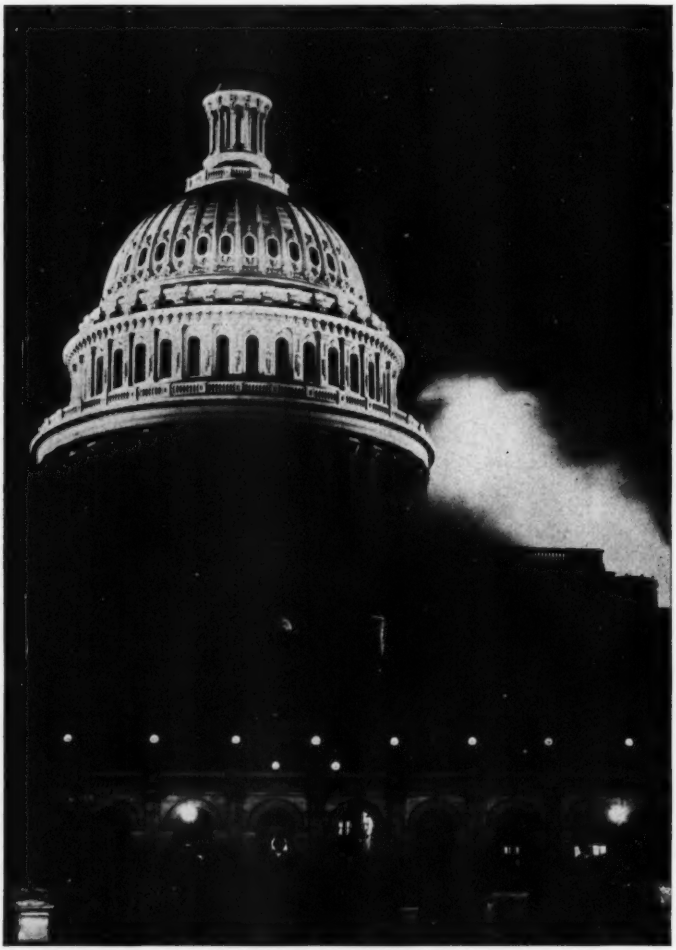
With regard to chemical combinations producing fire-quenching foam and similar effects, practical tests have shown that such combinations are little if any more effective in the open air than so much water, and since there is no superior merit in the use of chemicals of the kind, it follows that nothing would be gained by the use of bombs that would explode upon reaching the fire and scatter the contents over the flames.

The question of the use of gas bombs thus disposed of, the next question is as to whether it might be possible to carry enough water to extinguish forest fires by "artificial rain."

A rough calculation indicates that a plane of carrying capacity equivalent to that used in passenger service (twelve to fifteen passengers) might carry a sufficient amount of water to distribute the equivalent of 2/10 of an inch of rain over an area of 10,000 square feet, or 40 x 250 ft. along the front of the fire. This would, of course, presume a very early discovery of the fire and prompt attack, for after a fire had progressed beyond the incipient stage no small amount of water could be effective; also it would be unsafe to fly low enough to place the water accurately. On this suggestion the Forest Service comments as follows:

> The distribution of water over a forest fire by airplanes has not been given serious consideration by the Forest Service, because we feel that at our present stage of development we would not be warranted in experimenting with this plan of suppressing forest fires at the expense of other more promising leads. We do, of course, use water where it is available within pumping distance of the fire line. For this purpose we use portable pumps and one and one-half inch hose. We have found that even after the equivalent of four or five inches of rain have been deposited on an area it is necessary to watch fires controlled in this manner very closely, since smoldering embers may still be found deep in the duff. With this fact in mind it can readily be seen why more serious consideration has not been given to the use of water in conjunction with airplanes.
>
> While a rain of two-tenths of an inch will retard a going fire to some extent, it would not make it unnecessary for ground forces to trench the fire. The fact that water from an airplane would be deposited on bright, sunshiny days, when the humidity was much lower than when rain occurs, would of course make the distribution of two-tenths of an inch of water from airplanes much less effective than an equal amount of rain. In view of the foregoing it can be seen that the use of water-carrying airplanes cannot be expected to supplant the ground forces.

No immediate prospects of the use of airplanes in fire fighting operations may be seen. In any field other than aviation we might dismiss the matter from mind as an impossibility, but in aviation there have been so many examples of the accomplishment of the impossible that making any final judgment may be unwise. New developments in airplane design or in fire fighting equipment may some day make airplane fire departments fully practicable.



International.

The U. S. Capitol Fire.

This picture was taken at the height of the fire in the United States Capitol, Washington, D. C., on the evening of January 3, 1930. Originating in an artist's studio near the base of the dome, at a point difficult of access to the fire department, the fire damaged an adjoining document room before it was extinguished. A great volume of invaluable historic documents stored on wooden shelves in the attic space, with no proper protection against fire, fortunately escaped destruction.

1929 Fire Losses—U. S. and Canada.

Compiled by New York Journal of Commerce.

Fire losses in the United States and Canada amounted to $332,426,600 in the year just passed, according to figures compiled by the New York *Journal of Commerce* from their daily fire records. This represents an increase of approximately 10% over the $301,267,560 loss in 1928. The 1928 total, which showed a decrease of 6% from the previous year, was the lowest figure reported from this source since 1919. The increase in the losses for the year seems to have been due to an abnormal increase in losses since May. From this month onward the monthly losses have increased progressively.

The Mill Valley, California, fire in July, 1929, destroying one hundred and thirty homes and causing a loss of over $1,000,000 was the only major conflagration of the year. During the twelve-month period there were listed fifteen fires involving a loss of one million dollars or over as compared with twenty million-dollar fires in the preceding year.

Following is a tabulation of the fire losses by months for the years 1925 to 1929 inclusive. The comparative statistics compiled by the *Journal of Commerce* are now available for a fifty-one year period, as shown by the table on the next page.

	1925	1926	1927	1928	1929
January	$41,210,400	$41,118,750	$37,910,600	$43,260,800	$36,225,400
February	32,472,000	30,963,750	26,285,000	41,105,400	26,872,400
March	33,346,500	42,854,600	26,807,600	30,377,000	29,762,000
April	37,696,800	52,408,400	39,720,600	25,980,600	22,647,200
May	29,170,800	32,764,200	20,713,000	23,202,000	21,637,000
June	23,650,800	28,676,000	25,481,200	11,123,000	26,630,800
July	29,622,000	31,723,400	24,248,600	17,106,400	31,528,000
August	23,348,750	27,833,400	24,299,800	17,723,600	27,504,200
September	25,396,250	19,309,000	21,875,000	17,182,800	21,422,000
October	23,991,250	14,877,000	22,326,600	22,414,160	29,071,800
November	30,320,000	26,724,400	18,992,200	20,087,800	28,256,000
December	43,275,000	43,757,600	31,935,400	31,204,000	30,869,800
Totals....	$373,500,550	$393,010,500	$320,595,600	$301,267,560	$332,426,600

The fire loss figures of the *N. Y. Journal of Commerce* are based on estimates of fires involving loss of $10,000 or over, with a percentage added to cover small and unreported losses. These figures are not so accurate as, and are usually about a third smaller than, the statistics computed by the Actuarial Bureau of the National Board of Fire Underwriters which, because of the delays incident to compilation of complete records, are not published until later in the year. The *Journal of Commerce* figures are immediately available, and valuable for purposes of comparison.—ED.

$10,593,899,005 Since 1879.

The fire losses of the past fifty-one years, as compiled from the *Journal of Commerce* records, reach the vast sum of $10,593,899,005, as shown by the following table.

1929.....	$332,426,600	1912.....	$225,320,900	1895.....	$129,835,700
1928.....	301,267,560	1911.....	234,337,250	1894.....	128,246,400
1927.....	320,595,600	1910.....	234,470,650	1893.....	156,445,875
1926.....	393,010,500	1909.....	203,649,000	1892.....	151,516,000
1925.....	373,500,550	1908.....	238,562,250	1891.....	143,764,000
1924.....	377,529,250	1907.....	215,071,250	1890.....	108,803,700
1923.....	389,192,200	1906.....	459,710,000	1889.....	123,046,800
1922.....	410,889,350	1905.....	175,193,800	1888.....	110,885,600
1921.....	332,654,950	1904.....	252,554,050	1887.....	120,283,000
1920.....	330,856,625	1903.....	156,195,700	1886.....	104,924,700
1919.....	269,000,775	1902.....	149,260,850	1885.....	102,818,700
1918.....	317,014,385	1901.....	164,347,450	1884.....	110,108,600
1917.....	267,273,140	1900.....	163,362,250	1883.....	110,149,000
1916.....	231,442,995	1899.....	136,773,200	1882.....	84,505,000
1915.....	182,836,200	1898.....	119,650,500	1881.....	81,280,000
1914.....	235,591,350	1897.....	110,319,650	1880.....	74,643,400
1913.....	224,728,350	1896.....	115,655,500	1879.....	77,703,700

Total, 50 years.....$10,593,899,005

New Zealand Fire Losses.

The fire loss in New Zealand for the year 1928, as estimated by the Inspector of Fire Brigades, was £1,636,118. Converted into dollars and cents this represents a total loss of approximately $7,900,000, or a per capita loss of $5.65. This estimate includes all losses, both insured and uninsured, and represents the peak of a steadily increasing fire waste curve. Figures for the past ten years are available only for insured losses, but the table below, taken from the New Zealand Statistics of Fire Insurance, clearly indicates the seriousness of the problem.

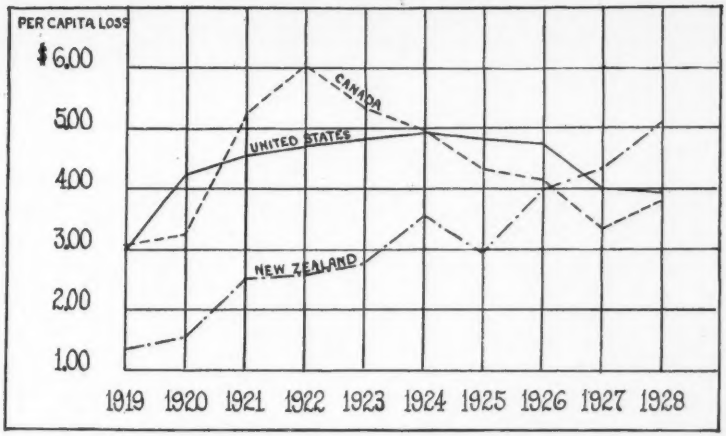
Fire Losses—1919 to 1928 Inclusive.

Year	No. Fires	Conflagrations*	Bldgs. Involved	Gross Loss
1919.....	2604	48	3057	£ 390,598
1920.....	2476	55	2923	448,656
1921.....	3001	66	3565	738,638
1922.....	3298	55	3681	739,076
1923.....	3636	51	3988	796,281
1924.....	4083	41	4405	1,046,328
1925.....	4018	28	4340	876,358
1926.....	4587	41	5014	1,127,140
1927.....	4983	46	5366	1,257,515
1928.....	No data	No data	No data	1,454,000

*Conflagrations are fires where more than three buildings were involved.

The accompanying chart shows New Zealand's rising per capita loss in comparison with the downward trend of per capita losses in North America. Canada's peak was reached in 1922 with a per capita figure of more than

This article has been prepared from data furnished through the courtesy of *Fire*, London, and Robert Fox, Esq. (Member N.F.P.A.), Wellington, N. Z.



Comparison of Fire Losses for Ten Years. New Zealand, United States, and Canada.

$6.00, and the United States in 1924 with $4.99. As in the preceding table, lack of data has necessitated the use of insured loss figures, so to bring the New Zealand loss curve on a basis fully comparable with those of the United States and Canada it would be necessary to add a percentage to cover uninsured losses.

New Zealand is made up of two large islands and a number of smaller ones, having a total area of 104,751 square miles, being about the same size as the State of Colorado and somewhat larger than Nebraska or Washington. The population in 1926 was estimated at 1,407,165, which is comparable with the population of the states just mentioned. There are four large urban centers with more than 20,000 population: Auckland with 192,176; Wellington 121,324; Christchurch 118,408; and Dunedin 85,703.

The country is generally mountainous. The climate is moist, and mild winters and genial summers are the rule. Earthquakes are not infrequent and several severe quakes were experienced this past year. The principal industries of the Dominion are boots and shoes, electrical equipment, dairy products, flax mills, furniture, foundries, grain mills, meat packing and freezing, saw mills, tallow, tanning, wool scouring, woolens and clothing, and machine shops. There are 5088 manufacturing plants in the Dominion according to latest reports.

Fire prevention and extinction matters are relegated to the Ministry of Internal Affairs, one of whose officials, Chief Thomas I. Hugo, is inspector of the fire brigades operating in the forty-nine districts within the Dominion. The personnel of the combined brigades consists of 222 professional, 407 retained and 462 volunteer officers and men. There are ninety-two fire stations.

Motor fire apparatus was in use as early as 1912, and most brigades are equipped with modern motor appliances. In the 49 fire districts are 39 motor pumps of from 100 to 900 g.p.m. capacity, four motor turntable escapes, and 74 motor tenders.

Street fire alarm systems are installed in 25 fire districts and are various in type. They include the duplex and simplex closed circuit systems, which are considerably used under the Southern Cross, and the open circuit with earth return. The remaining 24 fire districts rely on electrically operated sirens and manual bells.

All districts except three have water systems, and hydrants are of the single and double outlet type.

The efficiency of permanent fire brigades with greater fire fighting facilities in the cities is demonstrated by a comparison of urban losses with rural losses. Loss statistics for the four urban areas were as follows for the year 1927:

City	Population	Fires	Losses		Per Capita Loss
Auckland	192,176	653	£157,858	$766,000	3.99
Wellington	121,324	579	£112,410	548,000	4.52
Christchurch	118,408	439	£ 78,476	381,000	3.23
Dunedin	85,703	354	£ 50,967	247,000	2.88

Compared with five cities of the United States of 185,000 to 200,000 population, Auckland led the list for per capita loss. Second place was held by New Haven, Connecticut. Christchurch and Wellington held eighth and fourteenth places respectively in a group of fourteen cities of 110,000 to 125,000 population. Dunedin made a better showing, standing sixth in a group of eleven cities.

The severe loss record is, in a measure, due to the almost general use of wooden buildings for commercial, industrial and residential needs. In a statement made by Chief Hugo, the framing of more stringent building by-laws and stricter regulations governing electrical installations were pointed out as urgently needed. He further states:

> A factor in the rapid spread of fire, and consequently in the heavier comparative fire loss, is the lining of so many buildings with scrim and paper—particularly dwellings. In a short time the scrim and paper become dry as tinder, and a fire in a building so lined spreads throughout the structure without showing any intensive destruction in any one room.

Inadequate water supplies for fire fighting purposes have also been a factor in New Zealand's mounting fire losses. Water supplies from a fire fighting point of view apparently have not received serious consideration, either at the hands of water works engineers or the Loans Board (a government department). The only apparent concern is the provision of sufficient water for domestic requirements, and it is only when a big fire takes place, requiring a large number of fire streams, that the inadequacy of some of the supply systems is brought to light.

There is a tendency throughout the Dominion to use 4-in. mains, which obviously are inadequate for fire fighting purposes. Pressures in some instances are insufficient for fire service, and hydrants in some of the urban districts are of an obsolete or inefficient type.

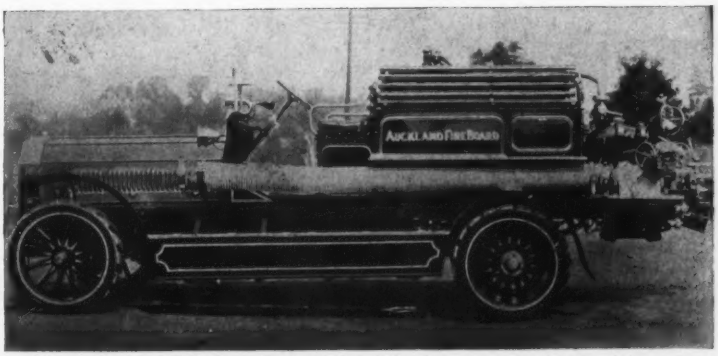
Many losses might have been prevented or reduced to a minimum through the use of automatic sprinklers and fire alarms. Of this phase of the problem, Chief Hugo says in his annual report:

After all the publicity that has been given in regard to the almost certain immunity from serious loss by fire in auto-protected buildings, the small increase in the number of installations is disappointing.

Much authentic evidence has been published from time to time in regard to the proved reliability and efficacy of the various auto-detector and sprinkler systems in eliminating the disastrous "late call," and so reducing to a minimum the losses due to outbreaks of fire in the larger risks.

The last annual report of the inspector pointed out in no uncertain terms the need of awakening a fire conscience in the minds of the people of the Dominion.

Carelessness in regard to fire and its consequences is too deeply ingrained to expect any radical reform in that respect in our present adult population, and one of the most effective means of reducing the prevailing excessive number of outbreaks of fire—and which at the present time is proving to be so in the United States and Canada—is the compulsory teaching of fire prevention in our schools and colleges, and by that method inculcating in the rising generation an individual sense of responsibility and care in respect to danger and loss by fire.



As early as 1912 New Zealand fire brigades were equipped with modern motor fire fighting equipment.

The Pathé Studio Fire.

The Pathé Sound Studio fire in New York on December 10, 1929, in which ten lives were lost, occurred in a building of fire-resistive construction with an ample number of exits. A quantity of motion picture film was stored in the building, but this did not contribute in any way to the loss of life. The primary cause of the casualties was the extremely rapid spread of fire in flammable scenery used in connection with the production. This building presented all the fire hazards typical of a theatre stage. On a theatre stage the law would have required the fireproofing of scenery, automatic vents above to carry the smoke and flame upwards, thus retarding the lateral spread of fire, and, most important of all, automatic sprinkler protection. If this building had been equipped with a standard system of automatic sprinklers it is believed that these ten lives would not have been lost.

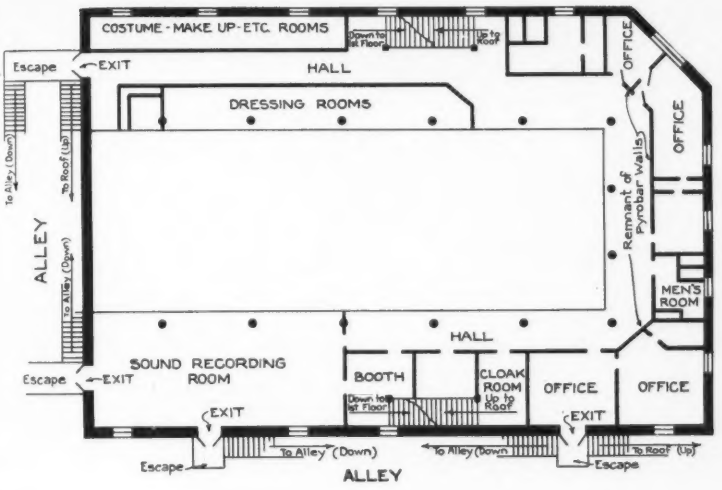
The Building.

The Pathé Sound Studio is located on the southwest corner of Park Avenue at 134th Street, New York City. The building was known as The

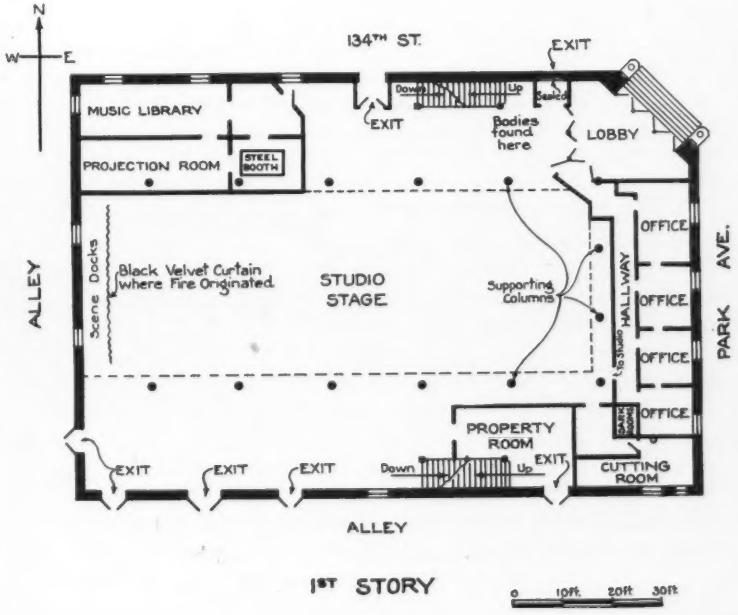
The Pathé Sound Studio at Park Avenue and 134th Street, New York City, prior to the fire.

Manhattan Studios and sub-leased by that concern to Pathé Sound Studios, Inc., for use in making sound motion picture productions. The studio was equipped with the usual paraphernalia for such work.

This report has been prepared from data furnished by the New York Board of Fire Underwriters (Member N.F.P.A.) and other sources.



MEZZANINE



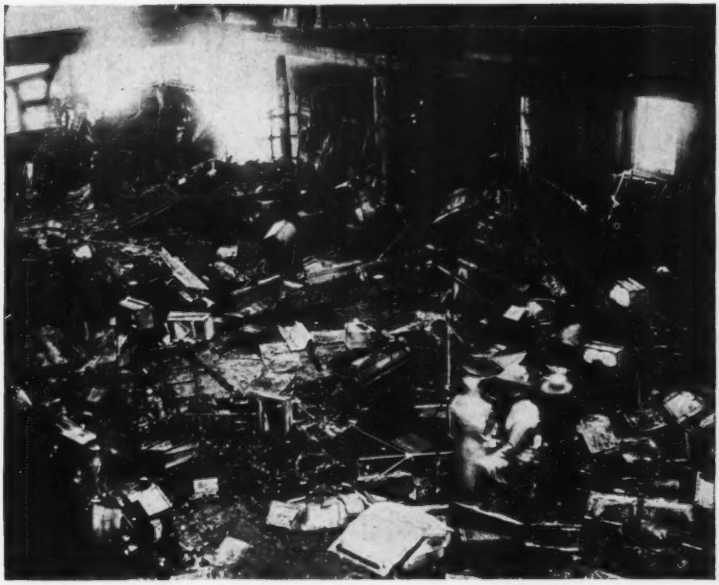
1ST STORY

The Pathé Sound Studio during the fire of December 10, 1929. Note fire alarm box on the corner.

The building was built in 1910 and was in good repair. The accompanying diagram shows the general arrangement. It is a high one story and basement building of fire-resistive construction, with a 20 ft. wide mezzanine on three sides of similar construction. The building covers an area of 11,250 square feet. It has brick walls and concrete floors with wooden surface in part. Partitions consisted principally of wood and composition board on wood framing, except offices on balcony and rewinding room, which were enclosed in fire-resistive partitions.

The occupancy of the building was that of a typical "sound studio." The contents of the ground floor included film cutting room, projection booth, screening room, stage, props, flood lights, scenery, sound recording apparatus, spot lights, stage settings, curtains and draperies, and sound deadening materials. Sound picture studios use more draperies, and use sound deadening materials and special lighting arrangements not formerly found in studios used for taking silent pictures.

All dressing rooms were on the mezzanine floor, which extended along the north wall of the building. There were two rows of such rooms, with a corridor between. This corridor was approximately 5 feet in width. One end of the corridor led to a stairway, which was a means of exit from the mezzanine to the main floor. The other end of the corridor led to a fire escape from the west wall of the building. There were several business offices on the mezzanine floor; also a projection booth and screening room on the mezzanine



Interior after the fire. Looking west from balcony.

on the south side of the building. From the stage floor to the ceiling was approximately 33 feet. The ceiling was covered with sound deadening material with no air chamber between this and the roof. The film storage vault was located in the basement.

Exits.

An ample number of exits is shown by the accompanying diagram. Every exit was equipped with an illuminated exit sign. It seems quite evident that these exits were not known or thought of by the majority of those at work in the studio, as the main entrance was the one resorted to by the majority for escape. This main entrance was located at the corner of Park Avenue and East 134th Street. At this point there were two large doors opening outward; however, these doors were not in general use and a draft and sound partition was erected around a third door, also opening outward. A single door, opening inward and provided with a door check was located in the partitioning. It was necessary to pass through the doorway in the partitioning first and then through the second doorway before gaining exit to the street from the studio floor. To reach this exit from the balcony it was necessary to descend the open five feet wide stairs, which had a platform with a right angle bend at the studio floor level, then across the studio floor a distance of approximately 15 feet before reaching the door in the partitioning. It was on the platform at

Make-up table in the scenery storage space in front of the curtain where the fire originated. The black velvet drop curtain, which may be seen just above the top of the mirror, presumably had been raised to allow the removal of scenery.

the foot of the stairs leading from the balcony toward this exit that the bodies of those that lost their lives were found.

Fire Protection.

The fire protection within the building consisted mainly of four two-inch standpipes, one near each corner of the building, supplied with water from city main connection only. Each standpipe had one outlet on the first floor and on the mezzanine, with 25 ft. of two-inch hose attached. A number of hand extinguishers were distributed throughout the building.

Story of the Fire.

On the morning of the fire there were 35 girls in the building, 12 members of an orchestra, three male actors and approximately 70 employees, including 34 electricians who were on the set and eight men in the property department. The girls in the dancing chorus of the "Black and White Revue," which was being filmed at the time, were in flimsy costume.

At approximately 9:38 A.M. fire started in a velvet drop curtain. (See diagram.) There are several causes to which the fire can be attributed, among them being a cigarette surreptitiously thrown into a fold in the black velvet curtain, an unknown electrical defect, or a fragment of carbon from an arc lamp. Another probable cause could have been an electric curling iron which might have been used and the current left on. The fire was first noticed in this curtain about "waist high" from the stage. This velvet drop curtain had been rented two days before the fire and placed in position the day previous.

Bottom of the fatal stairway. The bodies were found on the floor at or near this point.

An unsuccessful attempt was made to tear the curtain from its supports and to extinguish the fire by the use of a stream from the building standpipe system. The fire quickly spread to the other draperies and the flammable scenery within the studio, and was soon beyond control. A delay of perhaps three to five minutes in summoning the fire department was caused in this attempt to extinguish the blaze. One of the employees, however, ran from the building and sounded the alarm at a box immediately in front of the building. Upon the arrival of the fire department the interior of the building was a mass of flames and their attention was largely occupied with the rescue of those persons still within. A second alarm was immediately sounded, followed by a third and then a fourth, which brought a large array of fire fighting equipment to the scene.

Loss of Life.

Ten lives were lost in the fire, four of them girls belonging to the dancing chorus. Of the six men who lost their lives, three were electricians, one a property man, one a bookkeeper, and one a make-up man. About 20 other persons were injured in the fire, most of whose injuries were very slight.

Many of the girls were in flimsy attire and still in their dressing rooms on the balcony on the north side of the building. Others apparently attempted to reach the dressing rooms in order to save their clothing and other personal belongings. The spread of the fire was so rapid that the available exit on the mezzanine floor was ignored by these transient employees in their rush for the only exit with which they were familiar, this exit being the main one at the front of the building through which they had entered a short time before.

Others, in different portions of the balcony, unable even to reach the stairs, were rescued through window openings. The men killed presumably perished in attempts to rescue the girls. All of the bodies were found near the foot of the stairs leading to the balcony dressing rooms. The report of the medical examiner indicates that the deaths were caused by suffocation from the inhalation of carbon monoxide, such gas being formed by the incomplete combustion of any carbonaceous material.

There is no evidence of any fire drill discipline, which might have resulted in the use of other available exits.

An official of the Pathé Sound Studios, Inc., states that since the fire he has interrogated most of the people who were in the building at the time of the fire, and it is his belief that nine of the persons who lost their lives were either at one time out of the building or were in a zone of safety and could have gotten out had they not returned.

Motion Picture Film.

At the time of the fire there were 369 reels of nitrocellulose motion picture film in the building; of these 209 were in a vault in the basement. It is definitely established that 11 reels of motion picture film were burned in the fire, although in no way was this film a contributary cause to the spreading of the fire, and the indications are that the entire interior of the building was in flames before the 11 reels of film took fire. There were eight reels of film in the balcony projection booth, which burned, and three reels of film in the camera darkroom. The films in the cutting rooms and in the vault did not ignite and were uninjured except by water.

Property Loss.

The building itself is not severely damaged. Practically all windows and the doors at the exits were broken. Partitions and ceiling and wall finish were destroyed or damaged, and some of the gypsum block fireproofing was knocked from the columns, but apparently none of the structural steel was affected.

There is no evidence to indicate that this was an exceptionally hot fire, but rather that the temperatures reached were comparable with that of burning wood. The duration of the fire was about two hours; it was under control in one hour according to fire department records.

The loss of contents and equipment of the building is practically total.

Railroad Fire Hazards.

It is sixteen years since a number of railroad members of the N.F.P.A. decided to form a special group under the name of the Railway Fire Protection Association to study the application of fire prevention regulations to railroad properties. Railroad executives commonly shared the general public ignorance of the economic significance of the fire waste at that time and had been rather impervious to attempts at enlightenment through ordinary N.F.P.A. channels. Our railroad members believed that a special railroad fire protection organization might challenge the attention of their high executives and win more sympathetic attention to pleas for the elimination of certain hazards in railroad properties. This belief has been justified, as certain railroad presidents have in the past sixteen years become very much alive to the wisdom of cutting down the fire losses of their lines, and are giving to their engineers charged with this responsibility the encouragement once so conspicuous by its absence.

The case for railroad fire protection was most excellently stated in a brief paper presented at the Toronto meeting of the R.F.P.A. in October by Mr. E. B. Berry, Superintendent of Insurance of the Southern Railway System. Mr. Berry asked and answered the following question sometimes put to him, which he characterized as reflecting the mental attitude of indifference:

Why are we so particular in regard to fire prevention when the building is insured?

Upon this question Mr. Berry makes the following comments:

Fire creates a definite hazard to life—10,000 lives are sacrificed in the United States each year as a result of fire. Fire waste of any corporation or community is inversely proportional to the interest taken by that corporation or community in fire prevention and protection.

Indifference to conservation breeds carelessness and is the forerunner to economic degeneration; conversely, application of fire prevention principles develops carefulness and systematic order, necessary elements of efficiency and progress. Fire diminishes cash assets.

You repair property to retard depreciation and conserve investment, and for the same reason you remove hazards to prevent loss by fire. The cost of insurance for railroad risks is based largely upon loss record.

There is always an intangible operating loss—not covered by insurance.

Fire loss is an utter waste. Insurance collected helps to rebuild, but what fire destroys is gone forever.

The policyholder looks to the insurance collected to replace losses as a consequence of fire. This is a comforting thought to the individual, but insurance functions to distribute losses, and nothing can be done to restore the destroyed wealth. The thing that confuses is that losses by fire are looked upon as dollars of loss, which thought conceals the real truth that what we lose is not dollars but wealth, the thing needed to produce other wealth. If this thought is clear, you may appreciate what it means to the railroads to lose annually by fire wealth in property valued at eight million dollars ($8,000,000). Knowledge of fire prevention, and the application of it, will materially reduce the loss ratio.

In railroad properties, as elsewhere, Mr. Berry points out that it seems to be necessary, if any impression is to be made, to create a habit of caution and carefulness on the part of the individual employee, by constant reiteration and preachment of fire prevention. He says:

Each hazard in a property is reflected by a penalty; that is an additional charge in the insurance rate make-up. Construction, exposure, smoking, bad housekeeping, defective heating or lighting appliances, and excess area all call for a per cent charge added to the basic rate. Conversely, credits are allowed for the use of a reasonable minimum of combustible material in construction, clean and orderly conditions, safe installation and use of heating and lighting appliances, the elimination of excess areas by fire walls, and the provision of first aid fire fighting equipment. Conservation of facilities is as important as efficient operation, and it calls for daily supervision rather than spasmodic or periodical observation. Each unit of property should be inspected and treated as an independent risk.

Having the responsibility of guarding against fire hazards, installing fire protection, investigating fires, checking plans for all new or remodeled structures, passing upon location, operating and occupancy hazards of new industries, we must keep in touch with conditions of property and transportation hazards of our respective roads. We should be able to rely upon the officer in charge of property units to see that our rules and regulations are fully observed and the utmost effort exerted to obtain a minimum loss ratio.

Our effort is to influence thought in the direction of producing minimum losses as a definite accomplishment; in other words, we must develop a "positive" in fire prevention, or more specifically, a fire conscience, to the same degree now accomplished with respect to explosives. Let us accept individual responsibility to prevent fire, and refuse to tolerate for a single moment any known fire hazard that might be corrected. A fire cannot occur from a hazard removed.

There are three things we can do to a fire: prevent it—confine it—extinguish it. The first is the easiest and least expensive.

With continuous teaching of this sort the fire losses in railroad property are certain to be reduced, as a railroad has much the same aspect as any other industry in which constant contact can be made with the same employees, thus gradually evolving a homogeneous spirit.

The Railway Fire Protection Association has developed a useful fire protection handbook, and is interested in tabulating railway fire loss statistics. It does not attempt to duplicate the technical committee work of the N.F.P.A., in which it actively participates by representation upon our committees. Its object is to apply the principles of fire protection to the special field of railroad property, and in this effort all of our technical regulations come up for discussion, analysis and review. The railroads are actively coöperating in the efforts of our field engineering service and have assisted in the elimination of many hazardous conditions in private properties along their rights-of-way. A number of the largest roads are regularly making subscriptions to our field service fund.

The White House Fire.

By William H. Rodda (Member N.F.P.A.),
Underwriters Association of the District of Columbia.

On Christmas Eve, December 24, 1929, a fire was discovered in the Executive Office section of the President's residence, the White House, in Washington, D. C. Over two hours' active fighting by a large proportion of the District of Columbia Fire Department was necessary to subdue the flames, and the final out stroke was not sent in until the following morning, nearly twelve hours later. The fire is of peculiar interest because of the location and the fact that priceless records were endangered. Fortunately, the records and documents destroyed are easily replaceable and not of high value.

Construction.

The fire occurred in the extreme west end of the building in a section used as offices for the President and his clerical force. This section was built for temporary use in 1902 during President Roosevelt's administration and has been in use ever since. When he took over the presidency, Mr. Hoover had the section remodeled for more convenient use. The walls are of brick, mainly thirteen inches thick, and the floors are wood joist. A basement and first floor are of full story height, and above the first floor is an attic about seven feet high. Access to this attic is by a narrow wood stairway. Two stairways from the basement to first floor are also of wood and without protection. The roof is of metal on wood sheathing supported by wood joists, which are, in turn, carried by wood trusses of six-inch by six-inch timbers resting on brick walls. The attic floor is of wood on wood joists. Light and ventilation for the attic are provided by small windows, about twelve inches by thirty inches, all of which are covered by heavy iron bars and gratings. Skylights in the roof furnished light to the first floor and are enclosed in metal lath and plaster through the attic. Although heat for the building is furnished from the State, War, and Navy Building, across the street from the White House, there are fireplaces occasionally used. The fireplace chimneys are of brick with four-inch walls. The interior finish of the section is metal lath and plaster, except the attic ceiling, which was open joist. This wing is connected to the White House proper by a passageway on the basement level, with one side open. The construction and location are such that the main building of the White House was in little danger of being involved.

Occupancy.

The basement was used as offices by the clerks employed in connection with the Executive Offices. Some files located on this floor were in steel cabinets, but were not subjected to fire.

Underwood and Underwood.

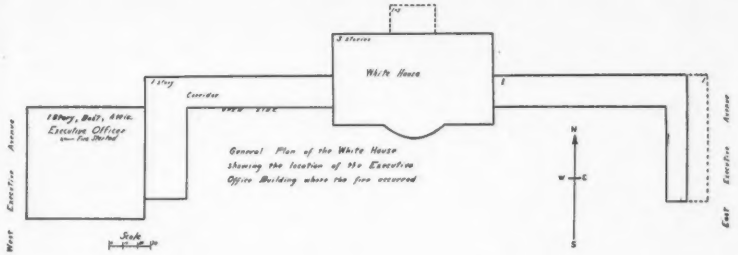
The west end of the Executive Offices during the fire. The heavy smoke from burning wood shelves and thousands of pamphlets can be seen coming through the windows and roof.

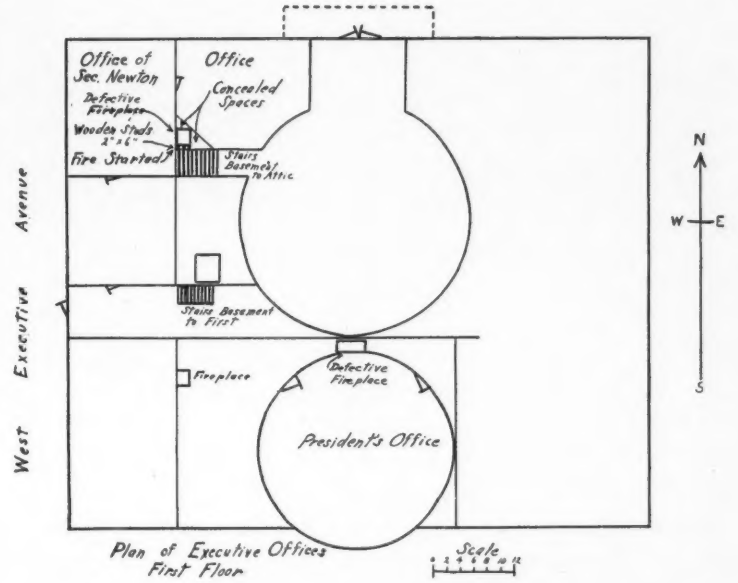
The first floor was occupied by the reception hall for the President's visitors, the President's private office, and the offices of the President's private secretaries. Such records and documents as were in these rooms were in desks and ordinary filing cabinets. Most of these were removed, but those remaining were not subjected to fire.

The attic was used as a file room. Wooden shelving in this room contained many thousands of pamphlets and records accumulated over a period of years. These were mainly printed government documents of which copies are available in other government departments. It was these pamphlets on wood shelves that made the fire very stubborn and hard to fight.

Story of the Fire.

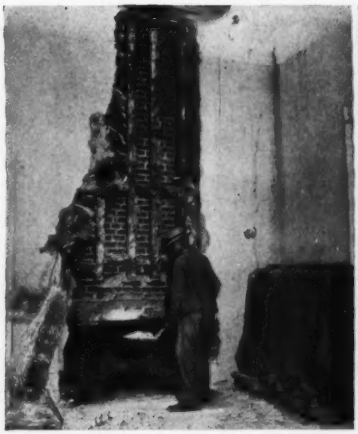
The fire was discovered by a White House guard who observed smoke in the Executive Offices. Other guards were immediately notified, and the White House private fire alarm box pulled by a guard at 8:09 P.M. The guards located the main body of fire in the attic and attempted to fight it with hand chemical extinguishers, but soon found it was beyond their control. The first alarm brought four engine companies, each with pumper and hose car, two truck companies and one rescue squad, a deputy chief, a battalion chief, and the chief engineer of the department. The chief engineer sent a second alarm at 8:16, bringing four more engine companies and one truck, a third alarm at 8:17 bringing four engine companies, a water tower and a truck; and





a fourth alarm at 8:28 bringing four engines and one truck. An hour later, at 9:24, a special call for three engine companies was sent.

The fire was attacked through the small windows in the attic, and considerable difficulty was experienced in breaking through the gratings. The windows were too small to make a satisfactory attack on the fire from them, and the best that could be done was to drive the fire back from the windows. Holes were cut in the roof and the fire fought from above. Heavy clouds of smoke and closely packed files inside made the fire very hard to find. Gradually the flames were stopped by means of streams through the holes in the roof, and the attic sufficiently cleared of smoke for the firemen to enter and overhaul. There was little fire visible at any time. Occasionally flames burst



Hugh Miller.

Left: The fireplace where the fire started, the back and sides of which are four-inch brick. The fire started near the floor on the right, directly behind where the workman is standing, and burned up between the studs to the attic above. The faulty construction is evident from the picture.

Right: A view of the President's private office, showing a fireplace similar to the one where the fire started. The fire in this partition dropped down from the ceiling after eating its way across the building from the point of origin.

forth from the attic windows and they burned through the cornice in several places. About a dozen hose lines were in use, with as many more held in reserve. By 10:30 P.M. sufficient progress had been made to send some apparatus back. Shortly after all apparatus except that of companies overhauling was sent back to quarters. At 7:27 A.M. the following day the out stroke was sent in.

Cause in Detail.

Investigation following the fire showed that there had been fire in partitions on the first floor, although there was no fire damage outside the partitions. The location of charred studs and evident path of the fire placed the origin at a wood stud against a fireplace. The construction of the fireplaces as revealed after the fire is decidedly faulty. The fireplaces themselves are built of one layer of brick, and in places those bricks have been shaved off so they will fit nicely against wood studs. This particular fireplace had been used on the day of the fire and firemen found embers remaining in the fireplace on their arrival. Another fireplace, all set to light, was piled high with kindling and logs. The result from a hot fire built in a fireplace with four-inch walls in contact with wood studs could hardly be other than what happened. The wood stud ignited and smouldered for several hours, spreading in the partition and finally burning through to the attic above, where it burst forth into flames. The spread from this point was rapid, the short time between discovery and the

Underwood and Underwood.

Another view of the fire fighting operations, showing the northwest corner of the Executive Office Building.

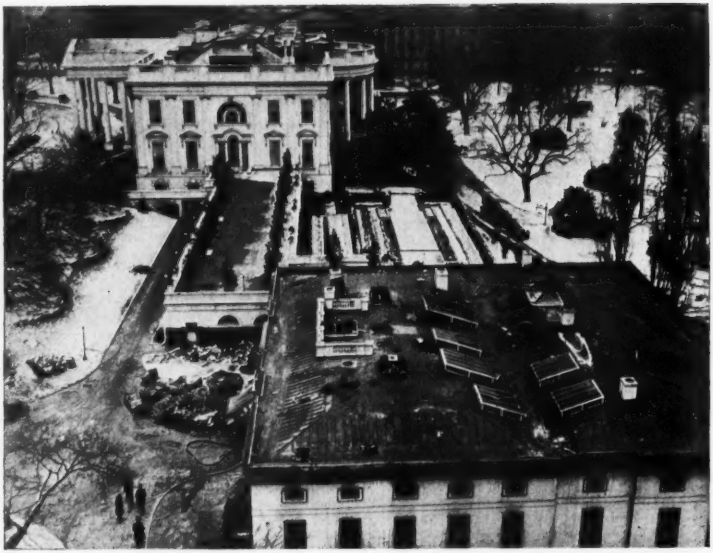
time the firemen got into action being sufficient to make the attic untenable. Had firemen been able to operate inside the attic the work would have been much simpler.

Damage.

The attic was well burned out. The roof boards and joists are largely burned away and the heavy trusses badly charred. The attic floor is badly burned, but the floor joists are mostly intact. The wood shelving and documents stored there are almost totally destroyed. The metal lath and plaster enclosures around the skylight wells to the first floor are intact, having withstood the fire very well. Fire damage on the first floor was confined to the partitions where the fire originated and some damage to ceiling joists.

Numerous holes were cut in the metal lath and plaster ceiling so the firemen could get at the fire in the attic and in order to determine if there was fire in the joist channels. Water damage on this floor was extremely heavy. The basement did not suffer from fire damage, but there was considerable damage to both building and contents from water.

The most valuable contents were removed from the basement and first floor by the President and his aids during the early stages of the fire. These were covered as far as possible by awnings and canvas available at the scene. Had salvage covers and equipment been available for use by firemen trained



Underwood and Underwood.

The Executive Office Building, with the White House proper in the background. Note the small windows from which smoke and flame issued, and the numerous holes cut in the roof by the firemen.

in salvage operations, water damage to contents could have been considerably reduced.

The entire roof and attic floor will have to be rebuilt, and probably most of the damaged section on all floors will have to be refinished. Considerable new plaster work will be necessary on the first floor. Fire department operations were well managed and every precaution taken to prevent spread of fire. The department deserves to be commended for keeping the fire within the attic in the face of the difficulties met. The building loss has been estimated at $60,000, and the contents loss is probably considerably less than that. There was no insurance loss, as the Federal Government carries no insurance.

Conclusions.

The cause of the fire was clearly indicated to be faulty construction of the fireplaces. Wood studs and furring strips were in direct contact with a four-inch fireplace and chimney, which is of course absolutely contrary to the accepted rules of fire protection.

The fire once more demonstrates very clearly the folly of combustible construction for important buildings, especially when they house operations and documents as valuable as those in connection with the Federal Govern-

ment. It is obvious, too, that standard protective measures such as used in mercantile and manufacturing plants would have avoided or reduced the loss. The following points stand out as imperative for the prevention of other such fires:

1. House all important operations, contents and records in buildings of standard fire-resistive construction.

2. Carefully supervise new construction, and reconstruct all existing heating apparatus, such as chimneys, flues and fireplaces to conform to accepted fire protection standards.

3. Have the entire buildings covered regularly by watchmen recording their rounds on approved clocks. Such a system with sufficiently frequent rounds would have taken the guards into the attic and assured earlier discovery of the fire.

4. Important records and documents should be kept in safes or vaults and not left in desks and ordinary filing cases. Such material as existed in the attic should be disposed of if worthless; otherwise it should be kept in vaults likewise. This material in connection with wooden shelving made this fire very difficult to extinguish.

5. Important buildings should be equipped throughout with an automatic fire alarm system, ringing an alarm in a central station where someone is always on duty. This will give immediate notice of any fire.

6. Where buildings of combustible construction or with combustible interiors must be used for a time, they should be equipped with automatic sprinklers, especially in basements, attics, closets and like places.

7. Salvage covers would have been of value in protecting contents from damage.

Cellulose Nitrate and Acetate Film.

By A. H. Nuckolls,[1]
(Member N. F. P. A.)

The unfortunate disaster at the Cleveland Clinic hospital last May disclosed nothing new regarding the dangerous properties of cellulose nitrate film, but awakened the public to a new sense of the danger involved in the storage of this type of film, particularly in respect to the poisonous gas hazard. Many previous film fires and explosions had been investigated and regulations[2] for the safeguarding of this hazard, developed by the N.F.P.A. Committee on Hazardous Chemicals and Explosives with the coöperation of underwriters, manufacturers of the film and other interests, have been in use for many years.

Hazardous Properties of Nitrate Film.

In the handling and storage of nitrocellulose, or, chemically speaking, cellulose nitrate, whether in the form of ribbon for motion picture film or in sheets for portrait and X-ray film, the danger is due to the unusually low temperature of decomposition or ignition of the film, its extremely rapid rate of combustion, and its ability to decompose (exothermic) even in a restricted supply of air (oxygen) with the evolution of explosive and poisonous gases.

Temperature of Ignition and Decomposition.

Many combustibles with which we are familiar, such as wood and paper, when heated rapidly do not ignite until a temperature in the neighborhood of 600 to 700° F. is reached. Cellulose nitrate decomposes when exposed to temperatures in the neighborhood of 300° F.[3]

The temperature of ordinary incandescent lights, steam pipes, as well as that of lighted cigarettes and matches exceeds 300° F. and may therefore become a source of ignition to the film. Hence, in the handling and storage of cellulose nitrate film, it is of great importance not to have any portion of the film near steam pipes, incandescent lights or any source of heat.

Combustion.

It is a matter of common knowledge that the chemical relation known as combustion is attended by the evolution of heat. The amount of heat develop-

[1] Mr. Nuckolls is chemical engineer of Underwriters' Laboratories and chairman of the N.F.P.A. Committee on Hazardous Chemicals and Explosives. This article is reprinted from *Laboratories' Data*.

[2] The Regulations for the storage and Handling of Photographic and X-Ray Nitrocellulose Film, adopted by the National Fire Protection Association in 1925 and published by the National Board of Fire Underwriters the same year. Recently an investigation by the Chemical Warfare Service has established the soundness of the principles on which these regulations are based. See Proceedings of the Board of the Chemical Warfare Service in an Investigation of the Disaster at the Cleveland Hospital Clinic.

[3] On prolonged exposure, decomposition of nitrate film may occur at temperatures as low as 230° F.

ment accompanying the combustion of unit mass of a given substance is known as its heat of combustion. The heat of combustion is recorded in terms of unit quantity known as the (gram) calorie, which is the amount of heat required to raise the temperature of one gram of water one degree Centigrade.[4] In place of the gram calorie the B.T.U., which is the amount of heat required to raise one pound of water one degree Fahrenheit, is often used.

The heat of combustion of a given substance is always the same, if the conditions of the chemical reaction are the same, regardless of whether the combustion takes place slowly or rapidly or occurs in air or in pure oxygen. The difference in the temperature effect between slow and rapid combustion of substances is primarily in the length of time during which the heat of combustion is evolved. In both slow and rapid combustion heat is rejected to external systems, but in slow combustion the heat exchange with external systems by thermal conduction, convection, and radiation results in a wider distribution of the heat units, and consequently the temperature effect is less than in the case of rapid combustion. In the absence of other factors affecting the result, we may regard the temperature as depending upon the number of calories evolved in unit time.

The heat of combustion of nitrocellulose is about the same as that of wood, being six to eight thousand B.T.U.'s, but the rate of combustion of nitrocellulose is from twelve to eighteen times that of wood (in the same form). It will be evident, therefore, that the temperature attained by the *free* combustion of cellulose nitrate is extremely high as compared with that of other substances commonly met with in practice. Film fires are therefore very difficult to control and may cause considerable damage within a very short period of time.

Exothermic Decomposition.

Most of the products with which we are familiar are formed from their elements or elementary substances with evolution of heat, and therefore on decomposition absorb heat. Cellulose nitrate is formed from elementary substances with *absorption* of heat and therefore on decomposition into simpler compounds evolves heat so that the process after once starting tends to accelerate itself.

Under practical conditions the decomposition of cellulose nitrate may or may not be accompanied by combustion,[5] depending upon the conditions, particularly as to the air supply. When stored in vaults and other closed places where the supply of air is restricted, decomposition of large quantities of film may occur within a relatively short time, as was the case in the Cleveland Clinic disaster.

[4] More accurately from 15.5 to 16.5° C.

[5] It is recognized that the cellulose nitrate molecule carries available oxygen which produces some oxidation of elementary substances even during flameless decomposition.

Explosive and Poisonous Gases.

When cellulose nitrate film burns freely in an excess of air the gases evolved are carbon dioxide, nitrogen and water vapor, none of which are poisonous.

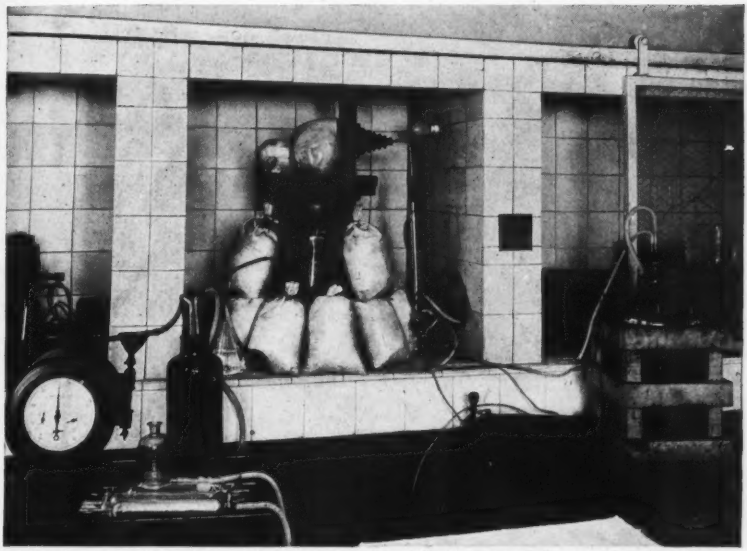
When cellulose nitrate film burns or decomposes (with or without production of flame) in a restricted supply of air, as would be the case in a closet or vault, carbon monoxide (CO), nitrogen dioxide (NO_2), and nitrogen tetroxide (N_2O_4) are evolved. Other gases, such as hydrogen, methane and traces or negligible amounts of hydrocyanic acid gas, and in case of undeveloped film, traces of hydrobromic acid, are also evolved. Under ordinary room conditions 1 lb. of cellulose nitrate film yields about 4 to 5 cu. ft. of these gases, which, of course, expand as the temperature rises, according to the well-known gas law. The proportions of carbon monoxide, oxides of nitrogen and hydrogen evolved depend in a measure upon the conditions, but the poisonous oxides of nitrogen and carbon monoxide are always produced by decomposition of nitrate film in dangerous quantity under conditions likely to be met with in practice. When the decomposition of the film takes place under pressure, as may be the case in a closed vessel or vault not provided with vents, hydrogen gas is evolved in considerable quantity.

It will be noted that when carbon monoxide or when hydrogen gas is evolved under conditions where the supply of air is not sufficient to cause their immediate combustion, a potential explosion hazard is introduced, inasmuch as these gases may be ignited later on when they reach a supply of air (oxygen).

The possibility of employing some gas or chemical to neutralize the poisonous gases evolved by the decomposition of nitrate film has been suggested. Gas to be suitable for this purpose evidently should be non-flammable and non-poisonous, and should have the property of forming non-flammable and non-poisonous neutralization products when combined with the poisonous gases from the film. This gas should be automatically liberated in case of a film fire, or the gas might be evolved by a chemical compound which could be stored with the film, and which on heating would evolve the neutralizing gas.

It appears that the only common gas which could be employed in the above manner to neutralize the oxides of nitrogen is ammonia, but ammonia is itself a poison even in very small concentrations (0.25 to 0.45 per cent by volume in air). It causes acute inflammation of the respiratory organs and edema of the lungs. Further, ammonia gas in high concentrations with air forms explosive mixtures.[6] It would therefore be impractical to store and liberate ammonia gas in sufficient quantity to neutralize the poisonous oxides

[6] For information on the explosive range of ammonia, see article by the writer entitled "The Fire Hazard of Ethane, Propane, Butane, and Ammonia as Refrigerants" (QUARTERLY, Vol. 19, No. 2, p. 168).



Burning Test Chamber, with apparatus for collection of products of combustion.

of nitrogen from a film fire without danger of having present an excess of the ammonia gas.

I think it is sufficient, without going into this phase of the subject more in detail, to point out that at the present time no gases or chemicals are commercially available for safely and effectively neutralizing the poisonous gases evolved by decomposing film. Of course, when ammonia water is available this may be used to some extent in neutralizing the oxides of nitrogen. Perhaps its proper application during the Cleveland fire might have saved a number of lives.

It is generally understood that fire extinguishing systems employing water serve only to extinguish or control film fires, but as a matter of fact, the application of water to decomposing film serves a double purpose, inasmuch as water reacts chemically with the poisonous oxides of nitrogen, changing them to nitric acid, which is soluble in water. In a well-sprinklered room in which films are stored, the bulk of the poisonous oxides of nitrogen evolved by decomposition of the film would be chemically acted upon and dissolved by the water. Unfortunately the poisonous carbon monoxide gas is only slightly soluble in water and cannot be effectively removed by this means.

It is apparent, I think, from the foregoing considerations that when cellulose nitrate film is used in hospitals adequate provision should be made for its safe handling and storage, having in mind the low ignition and decom-

position temperature of the film, its extremely rapid rate of combustion, and its ability to decompose with the evolution of explosive and poisonous gases. The importance of complying with the Regulations on X-Ray Film cannot be overestimated.

Cellulose Acetate Film.

Manufacturers of slow-burning film having a cellulose acetate base first submitted samples to the Laboratories for test about twenty years ago. Following an extended investigation, the acetate base film in the form of ribbon for motion pictures was listed by the Laboratories as slow-burning, the fire hazard being somewhat less than that of common newsprint paper in the same form and quantity. This type of film, however, did not come into general use immediately, probably on account of the superior qualities of the cellulose nitrate film for photographic purposes. Recently, however, the manufacturers of acetate film have succeeded in improving its qualities to a marked degree, and this type of film is now quite generally used, particularly in projectors of the non-professional or miniature type, which may be operated in public without a standard booth if the slow-burning acetate film is used.[1]

Ignition Temperature.

The ignition temperature of cellulose acetate is between 700 and 800° F., as compared with about 300° F. for cellulose nitrate.

Decomposition.

A temperature of about 500° F. is required to produce decomposition of cellulose acetate film. In the neighborhood of this temperature the evolution of fumes in material quantity occurs.

The decomposition of cellulose acetate film, however, is not exothermic, as is the case with cellulose nitrate. In other words, the decomposition of cellulose acetate film once started does not continue except under conditions where there is an external source of heat. It will be noted that in the case of cellulose nitrate film the decomposition continues when once started, even in the absence of an external source of heat. This difference between the decomposition of cellulose nitrate film and that of cellulose acetate film is therefore of great importance from the fire and life hazard standpoint.

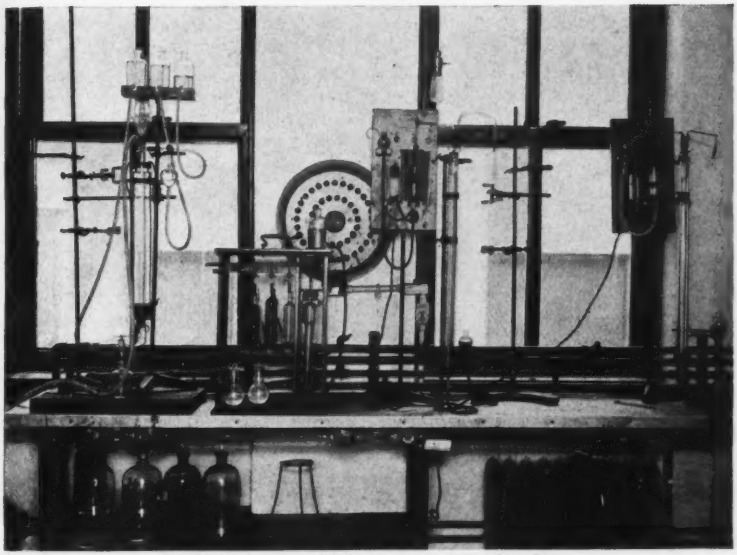
Combustion.

The cellulose acetate film continues to burn when once ignited if the supply of air is sufficient to freely support combustion. The combustion, however, will cease in a restricted supply of air. The rate of combustion of cellulose acetate film is relatively slow, and the amount of heat evolved is of a low order, being much less than that of paper or wood.

Evolution of Gas.

Like all cellulose products, cellulose acetate on combustion or decomposition gives off irritating and suffocating fumes. During the last ten years

[1] See National Electrical Code, Article 35, Motion Picture Projectors and Equipment.



Apparatus for analysis of gases from film fires.

engineers of the Laboratories' staff have frequently had occasion to make decomposition and combustion tests with cellulose acetate films. On several occasions workers have been exposed to these fumes without any ill effects. Of course, in high concentrations the fumes would be so irritating and suffocating as to cause workers to leave the room. In tests on cellulose nitrate films it is, of course, necessary to avoid breathing the oxides of nitrogen and carbon monoxide gases evolved.

Research work conducted at the Laboratories to determine the exact chemical nature of the fumes evolved by cellulose acetate under different conditions of decomposition and combustion is described in a paper entitled "The Smoke and Fume Hazard of 'Safety' X-Ray Film," by Dr. C. A. Tibbals, published in *Laboratories' Data*. The following is a synopsis of the paper:

About one cubic foot of gas per pound of film (eight to nine 14 by 17 sheets) is formed under influence of heat in absence of air. The composition of the gases varied with conditions of formation, typical analysis being shown. Vapors condensable at ordinary temperature were also investigated. The aqueous portion of the condensate was about sixty per cent acetic acid, the remainder being water together with a small amount of aldehydes, alcohols and ketones, and a minute amount of cyanides. The non-aqueous portion of the condensate was similar to wood tar except it contains considerable acetic acid. A small amount of hydrobromic acid was found in case of undeveloped film.

The formation of fumes ceases promptly when the source of heat is removed.

The fumes formed during burning of the film in a restricted supply of air consisted of small amounts of condensable tarry acid vapors and water insoluble gases containing

normal product of combustion, the quantities of carbon dioxide and carbon monoxide being greatest with maximum restriction of air supply. The maximum carbon monoxide found was 2.8 per cent. A very small amount of bromine was present in the fumes from unexposed film. No trace of cyanides was found. Less than 16 parts per million of phosphine was found in the fumes from film containing organic phosphate.

Consideration of all data of all the tests made upon burning cellulose acetate film confirms our previous conclusion that cellulose acetate base film is in a class with ordinary paper in similar form and quantity in respect to the hazard to health and life, of its smoke and fume in a fire.

It will be noted that one pound of cellulose acetate yields about 1 cu. ft. of gas when heated in a closed vessel without access of air. These gases include principally carbon dioxide, carbon monoxide, hydrogen, methane, alcohols, acetic acid, ketones and aldehydes.

Under practical storage conditions the acetate film will, in case of a fire, be subjected to combustion in a more or less restricted supply of air (oxygen). In this event the combustion will be accompanied by some decomposition. Under these conditions most of the hydrogen, methane and carbon monoxide will undergo oxidation or combustion, but sufficient quantities of carbon monoxide (about 1 per cent) may be evolved to render the air surrounding the fire, particularly if in a closed room, dangerous to breathe,[8] as would be the case in the combustion of paper under similar conditions. The acetic fumes, aldehydes, and ketones are irritating and suffocating, but are not comparable in their poisonous effects with the deadly oxides of nitrogen evolved by the decomposition of nitrate film.

I think that the most important safety factor with reference to cellulose acetate film is its slow combustion, which can be easily extinguished by application of water or by smothering the fire. It is therefore possible to readily provide measures for controlling film fires involving cellulose acetate. In small quantities the film can be safely used for purposes of amusement without any special safeguards, but where large quantities of cellulose acetate film are to be stored in hospitals, I think it would be advisable to provide a cabinet or vault,[9] preferably of fire-resistive construction, for the protection of the patients from the fumes in case of a fire.

[8] The average percentage of carbon monoxide in 32 analyses from seven burning tests was 0.8, the maximum in any case being 2.8 per cent. In similar tests with paper the average percentage of carbon monoxide was 0.9, maximum 2.5.

[9] Cabinets or vaults for acetate film need not be provided with vents.

Consolidated Film Laboratory Fire.

The fire which destroyed the film laboratory of Consolidated Film Industries, Inc., at Hollywood, Cal., on October 24, 1929, is of interest because of the large concentration of values involved in a laboratory of this character. It is remarkable for the fact that, although the quantity of nitrocellulose film burned was several times greater than that in the Cleveland Clinic fire, only one fatality resulted and no permanent ill effects were noted by firemen engaged in combating the flames. The small loss of life is due in part to the free burning of the film and in part to the fire occurring shortly after midnight, when only 27 employees were in the building and but five in the room where the fire originated. At times 35 to 40 girls were employed in this room.

This plant was engaged in developing, printing and otherwise preparing for release, motion picture film for a large number of producers, probably doing more business than any other commercial laboratory in Los Angeles. Fire originating at a polishing machine in the positive assembly room gutted the two-story laboratory and damaged the contents of one sprinklered storage vault; five other vaults were undamaged.

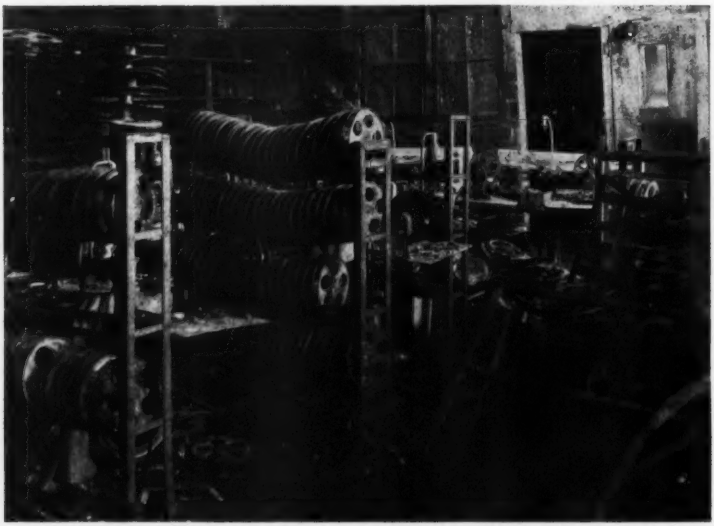
Description of Building.

The main laboratory is a two-story reinforced concrete building, with a partial basement, constructed in 1920; 75 by 135 feet in plan. A one-story addition of similar construction, 32 by 72 feet, was completed in 1928. Walls, floors and roof are of reinforced concrete; some partitions are of the same

International.

Consolidated Film Laboratories, showing the southeast corner.

This article has been extracted from a joint report prepared by the National Board of Fire Underwriters (Member N.F.P.A.) and the Board of Fire Underwriters of the Pacific (Member N.F.P.A.).



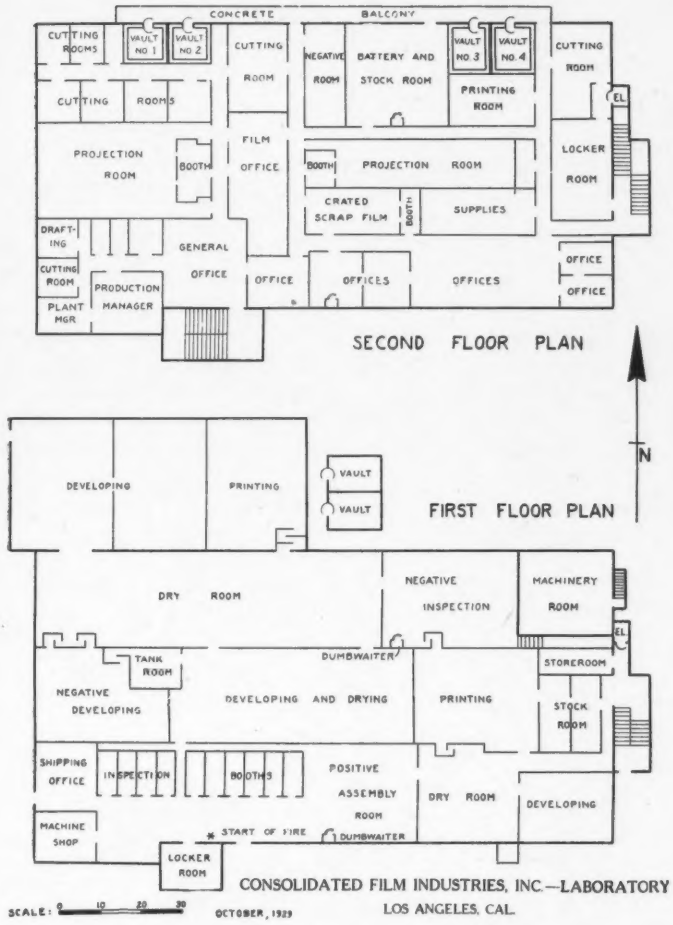
East end of positive assembly room, first floor, south side. Note general overcrowding; at times 35 to 40 girls were employed in this room.

construction, but most are either of hollow tile plastered or of sheet metal on steel channel bars. Basement is used as engine room, and directly above this is the fan room containing ventilating and air conditioning machinery; both rooms are separated from the remainder of the structure by unpierced concrete walls.

Four vaults are located on the second floor, in two groups, with doors opening on to a balcony along the north side of the building; walls and floors are 12-inch concrete; roof is a 4-inch concrete slab. Except for the outside wall, these walls are surrounded by a facing of 3-inch hollow tile filled with concrete. Adjacent vaults are separated by a 6-inch air space. Vaults are approximately 503 cubic feet in capacity, equipped with automatic sprinklers, 12 heads per vault, with proper baffle plates. Vents are 10 square feet in area.

The two vaults located in rear of laboratory are old vaults moved from another plant; of reinforced concrete, equipped with sprinklers but having as vents only three 3-inch pipes through the rear walls, near the floor.

The plant was not equipped with automatic sprinklers, except in the vaults. Hand chemical extinguishers of the soda-acid, foam and carbon tetrachloride types were liberally distributed, and there were four inside and one outside wet standpipes with $1\frac{1}{2}$-inch hose attached. A night watchman was employed and eleven A.D.T. boxes were distributed about the building. Forty-four carbon tetrachloride bombs were installed a short time before the fire.



The first floor of the laboratory contained stock and store rooms, but was used principally for developing, printing, drying and assembling. The positive assembly room in which the fire originated is located on the first floor, on the south side of the building. It was used for inspecting, splicing, polishing and waxing the finished positives. Machines and tables were closely spaced and the room was overcrowded. The second floor was devoted to offices, cutting rooms, projection rooms, and the four film vaults; two other vaults were located outside the building.

Film on Hand.

All film was of cellulose nitrate. In the positive assembly room, a rack along one wall had space for 750 reels, a series of sheet metal cabinets contained about 720 reels and portable racks, each of which had capacity for 100 reels, contained an unknown number. The closeness of their spacing is shown in the illustration. Although not all the reels were full, a conservative estimate of the film exposed in this one room is 1,500,000 feet or 7500 pounds. No cans were used.

Indications are that at least 5,000,000 feet or 25,000 pounds of film were kept outside vaults in other parts of the building. A considerable portion of this was raw stock in cans in original wooden shipping cases, partly on the first floor and partly on the second. A room next to vault No. 3 on the second floor contained a large amount of film in cans stacked on the floor.

The cutting rooms occupied by the various film producers contain varying amounts of film, usually comparatively small. Scrap film was generally kept in sacks or wooden boxes, few self-closing metal cans being used. This scrap is said to have been removed each day and burned in an incinerator outside.

Polishing Machine.

The machine in which the fire originated is used for cleaning and polishing the celluloid side of the film by means of buffing wheels. Film is moistened with a compound containing alcohol and carbon tetrachloride and carried by a belt at the rate of 160 feet per minute under a pair of buffing wheels covered with felt whose rim speed is 7000 feet per minute. The machine has a wooden frame and the various parts are not grounded except that the motor frame is connected to the conduit system.

Smoke was first noticed coming from the take-up reel on this machine, the film quickly bursting into flame. The two most plausible causes of the fire are friction and static electricity. Weather conditions were favorable to the building up of static charges, the relative humidity having dropped to 24 per cent at the time of the fire. No trouble is said to have been experienced with the machine, and an inspection of the motor shows it was properly wired.

Story of the Fire.

Immediately upon discovery of the fire the alarm was given and employees hurried from the building. The fire spread so rapidly that several girls suffered slight burns; no attempt could be made to extinguish the flames. One man, a developer, working in one of the dark rooms, either became confused as to location of exits or returned for some reason and was asphyxiated.

The fire department received the first alarm at 12:34 A.M. from a box three blocks distant; another box, which was unused, was 400 feet from the building. Upon arrival, the acting battalion chief in charge at once sent in a third alarm. By this time, eight minutes after the first alarm, the entire building was involved, pressure of the gases given off driving the flames across the

entire width of Melrose Avenue, burning nine automobiles parked in the street and setting fire to three building fronts on the opposite side, 103 feet distant. A series of distinct puffs of gas or possibly explosions was noted. The interior of the building was a mass of white-hot flame; comparatively little smoke and few burning particles were thrown off. Fire spread to the second floor chiefly by means of the east stairway and also by the dumbwaiter shafts, which were not sufficiently tight to prevent the passage of gases. Windows and skylights in the first story and the eastern half of the upper story were melted or blown out almost immediately.

Polishing machine, where fire started.

Fire department response consisted of seven engine companies, one hose company, two ladder companies, salvage company, rescue squad, and searchlight car. The water supply was adequate. Seven or eight fire streams were used by the department and one by the Radio-Keith-Orpheum private brigade, but because of the enormous quantity of film which had been heated up to the decomposition point and the terrific heat generated by the burning gases, this water had little effect towards putting out the fire for 15 or 20 minutes, or until the major portion of the film had been consumed. The flames were prevented by the fire department from reaching the cutting rooms in the northwest corner of the second floor. As soon as the fire subsided enough to allow firemen to enter the building, cans of film were opened and inspected carefully; small hose lines were used to put out any smouldering reels.

The contents of vault No. 4 were somewhat damaged, mostly by water. This may be accounted for in two ways. The more probable theory is that a square container, improperly placed in or on the metal rack, was thrown to the floor by the shock of an explosion or a falling partition. Striking the concrete floor from the height of several feet, the can was burst open and the two rolls of film it contained were spilled out, directly under the vent. The asphalt on the roof had been burning freely, the fire reaching the flashing under the metal hood which covered the vent opening. This had been treated with asphalt to make it waterproof, and the melting or flaming asphalt, dripping into the vault, presumably struck the exposed film and ignited it. The two rolls of film burned, setting off three sprinkler heads, which extinguished the fire.

International.

Interior of wrecked laboratory, showing drum used for drying film.

The other theory of the ignition of this film is that a blast of hot gases from a skylight on the opposite side of the roof was deflected horizontally by the top of the skylight in such a manner as to enter the vault through the vent. This blast heated the film in one can to the extent that disintegration began, the cover was forced off by the gases generated in the can and the film ignited, the can being subsequently knocked down by water from the sprinkler heads. This theory is rendered less plausible by the facts that sprinkler heads directly under the vent were unopened, and that the ashes of the two rolls of film were intact, indicating they burned where they fell.

Results of Fire.

The building itself suffered little damage to the structural portions of reinforced concrete, but much costly equipment, specially designed for an unusual business of a highly technical nature, was destroyed. Although plaster was spalled off wherever subjected to intense heat, the fire was of short duration, and the heating of the substantial structural features was comparatively slight. Preliminary examinations of the reinforced concrete columns, beams, walls, floors and roof showed little or no cracking, or breaking away of the concrete from reinforcing steel. There was no apparent sagging of beams or warping out of line of columns.

Two partitions of 3-inch tile, plastered on both sides, were thrown down by fire department hose streams; neither had been anchored to the ceiling in any way. A third partition of similar construction was wrecked in an unknown manner, probably by an explosion. Sheet metal partitions and their steel sup-

porting members showed little ability to resist heat and were warped and twisted in proportion to the heat encountered. Except in the rooms noted below, all wooden furniture and trim was destroyed.

The fire was well ventilated, partly by the falling out of the plain glass in windows under the influence of heat and partly by the opening of skylights by firemen. In rooms containing only normally combustible materials its progress was quickly stopped. A group of cutting rooms in the west part of the second floor was practically undamaged, and light globes in two near-by projecting rooms were intact, indicating little heat. Sections of the building properly cut off, namely the engine room and auxiliary machinery room, were not damaged. The condition of the stairway at the east end of the building and of the dumbwaiter shafts indicates they contributed to the spread of the fire from the first to the second story. The fire may have traveled externally from window to window, but communication to the roof was through skylights.

The outer door of Vault No. 4 was warped by heat from the outside; the inner door was not affected. Apparently the concrete balcony, on which the vaults open, did much to shield the doors from the intense heat issuing from the windows below them. All film in this vault was stored in cans, many of which were not water tight and considerable water damage resulted; during the later stages of the fire a 3 by 3-inch short radius tee in the sprinkler riser just below the balcony level burst at a point where the heat had caused expansion and buckling of the pipe system.

A quantity of raw film in the original shipping cases was unharmed. The film was packed in tight metal containers in wooden boxes, and the insulation of the unbroken package was sufficient to prevent, for the brief duration of the fire, the temperature of the contents being raised to the decomposition point.

The maximum temperature developed inside the building was probably between 1600 and 1700 degrees Fahrenheit. These figures are arrived at by noting the effect of the fire on various substances. Both plain and wired glass melted freely, as did lead, zinc and alloys containing a large proportion of either. On the other hand, objects of bronze, cast iron and steel, such as hardware, lighting fixtures and conduits, and various pipe systems were not melted.

Conclusions.

Except as emphasizing the severe hazard of nitrocellulose film, this fire teaches no new lesson. The nature of the material, its rapidity of burning, the life hazard introduced by the gases, and the values involved in an occupation such as this all lead to the same conclusions.

The one factor which caused the extremely rapid spread of the fire was the immense amount of exposed film in the positive assembly room. In view of the large concentration of values in a laboratory of this character, and of

Firemen dumping film and cans. An idea of the quantity of film involved in fire may be obtained by the size of the piles of débris.

the scores of lives at stake, there is no justification for the disregard of all reasonable limits. The efficiency of operation is not increased by permitting the accumulation of exposed films which have been completed or on which work is to be done. The cost is comparatively small of observing such precautions as those of keeping films, not actually being worked on, in containers; of providing vaults or properly insulated and vented cabinets; of storing raw stock in a room cut off from the rest of the building by double fire doors; of keeping all completed film in vaults; and of locating hazardous machines, such as polishers and waxers, in separate rooms. Moving parts of machines, in which static charges are likely to be built up, should be grounded.

The fire served to corroborate ideas previously held concerning film fires, burning with quick, fierce heat characteristic of nitrocellulose products. That so large a quantity of film could be consumed without numerous fatalities was due to the time of occurrence, when few employees were about, and to the fact that the building vented itself and allowed the fumes to burn outside in an adequate supply of oxygen. Gaseous products given off by nitrocellulose compounds vary in their composition and percentage with the conditions of pressure and temperature under which fire or decomposition takes place. A flaming combustion in the open air gives rise to very little smoke or fumes; only small amounts of carbon monoxide and oxides of nitrogen are formed;

flameless combustion, on the other hand, is productive of large volumes of dense smoke and toxic gases.

It is of the utmost importance that buildings which are intended for the handling of large quantities of nitrocellulose compounds be so designed and constructed as to avoid incomplete combustion and the accumulation of explosive and poisonous gases. This is absolutely essential for the safeguarding of life and property. The excellent way in which structural features of the building withstood the fire demonstrates the suitability of reinforced concrete for this type of occupancy. As an aid to ventilation, windows and skylights should be arranged to open automatically or have plain glass. Fire doors separating the various sections should be self-closing rather than automatic. Above all, exits and aisles leading to them should be provided so that every part of the building may be promptly vacated.

The value of automatic sprinkler protection in vaults was amply demonstrated. In one vault there was considerable water damage, but without sprinklers the entire contents would have burned. This vault was used mainly for storing daily "rushes" and with the frequent handling the containers were not in the best of condition, being battered at the corners and covers fitting loosely. Had the container which fell been placed more carefully in the rack, and had all the containers been in better condition, it is probable there would have been no damage. Vents of vaults should be so located or extended about the roof as to eliminate danger from flaming gases coming through skylights, and designed to prevent entrance of molten roofing asphalt. This fire emphasizes the need of isolated vault storage for valuable negatives and for dead storage.

This extinguishment of the vault fire and experience in other fires show, beyond a doubt, that fires in film laboratories can be held in check by automatic sprinklers closely spaced, provided a proper degree of care is exercised in preventing large accumulations of exposed film. Ordinary first aid fire equipment is of little value when the film is well ignited, and only water in large quantities is effective in controlling such a fire. Most fires are extinguished when the supply of air is cut off. Nitrocellulose, however, contains sufficient oxygen so that it will continue to burn when enclosed with a restricted supply of air. Consequently the only means of extinguishing a nitrocellulose fire is to cool the burning material below the ignition temperature. Since water has a high specific heat and a very high latent heat of vaporization, it is the logical means of extinguishment for film fires. In addition, it has the advantage of absorbing a large portion of the gases evolved.

Salt Lake City Film Fire.

Report by A. J. Snow,
Board of Fire Underwriters of the Pacific (Member N.F.P.A.).

Three explosions in quick succession, resulting from the ignition of nitrocellulose motion picture film in a basement laboratory in Salt Lake City, Utah, on October 23, 1929, cost the life of one man, seriously burning a second. Two others were rendered unconscious by the fumes from the burning film.

The laboratory in which the fire occurred was located in the basement of the Union Pacific Building, occupied above the basement by a newspaper office and as an office building. The laboratory occupied a comparatively small section of the basement, and had but one exit served by an ordinary door with a glass panel. This door opened directly into a steep stairway which led up to the street. It was stated by the surviving partner of the firm that there was probably from 20,000 to 25,000 feet of film in the laboratory at the time of the fire. There is no evidence that any of the usual precautions were observed in the storage and handling of nitrocellulose film. There were no automatic sprinklers.

The fire and explosion occurred at 11:15 A.M. The two owners of the laboratory, brothers, were at work at a bench rewinding a roll of motion picture film when suddenly the film ignited. The first theory as to the cause of this ignition was that it was caused by a spark generated by friction or static electricity due to the rapidly whirling wheel. Subsequent investigation by fire department officials, however, brought forth the theory that the fire

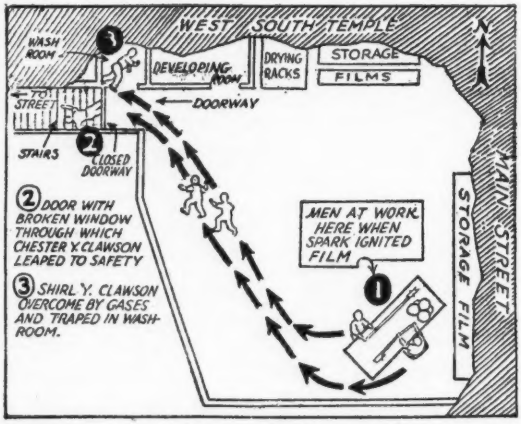


Diagram showing attempt of occupants to escape from basement film laboratory fire in Salt Lake City.

Interior of Clawson Film Laboratory, Salt Lake City, where one man lost his life and his brother was seriously burned when film ignited.

was caused by the film breaking and coming in contact with an open coil electric heater, which was being used at the time, or a broken electric light globe.

The brothers apparently attempted to control the fire with a hand extinguisher, but abandoned their efforts when the fire began to spread to other film on a wall cabinet near the bench. The first burst of flame was, within a matter of seconds, followed by an explosion, and the intense heat ignited films stored in wall cabinets about the room. The explosion caused the door (opening inward) to close with a bang, and locked it, and the pressure of the gas generated by the burning film made it difficult to open. The two men rushed for this single exit and smashed the glass panel, but the rush of flame and gas through the opening made escape seem impossible, and they fell back into a little washroom adjoining. They quickly realized their plight—that suffocation in this little cubbyhole was certain, and another desperate effort was made to escape. One of them was successful and reached the street. He was taken to a hospital seriously burned and bruised. The other remained in the washroom and his body was found there by firemen. Death was due to suffocation.

The fire department ventilated the basement by smashing the glass sidewalk lights, and hose streams were brought into play through the opening

thus made. Firemen wearing gas masks made their way into the basement in an effort to rescue the trapped man. As they were placing a rope about the body the third explosion took place, throwing the mask from the face of one of the firemen, who was overcome by the acrid fumes.

Fumes penetrated the building and the elevator operator was overcome. A number of others were slightly affected. The Board of Health ordered the entire building evacuated to prevent possible danger to office workers, the order being effective until the following morning. At 5:30 P.M. a suction furnace cleaning truck was procured and put into operation to clear the lingering fumes from the laboratory. This was most successful, according to fire department officials. Property loss was estimated at $10,000 in record film and $5000 in miscellaneous film and equipment.

California Hospital X-ray Film Fire.

A fire originating in nitrocellulose X-ray film occurred in San Francisco on the morning of November 18, 1929, in the main building of the University of California Hospital. Despite the potential life hazard involved, the building was evacuted without casualties, due to good discipline and the fact that no very large amount of film was involved in the fire.

The building, five stories in height, was of steel and concrete fire-resistive construction. The room in which the fire occurred was on the third floor and was used for viewing X-ray negatives and for their storage. It was about 15 x 25 feet in area and was cut off from the corridor by a 2-inch door of wood veneer with a plain glass transom. Three large plain glass windows faced toward the street.

The furniture in the room consisted of two portable X-ray viewing stereoscopes, wooden view cabinets and shelving for storage of film. One of the stereoscopes was lighted by two 200-watt lamps in chambers under the glass sheets, on which two negatives may be laid for examination, and the other was lighted by 100-watt lamps. Wooden viewing cabinets were built against walls at each end, extending almost the full width of room, for viewing series of related cases. On shelving beneath the viewing boxes, films in manila paper envelopes were pigeonholed. The quantity has not been determined satisfactorily, but is estimated to have been from 150 to 300 pounds. Some filing cabinets for card indexes, chairs and table made up the rest of the furniture.

Methods of handling films were generally good, and an attendant was regularly on hand. However, doctors had access to the room for emergency purposes at odd hours, and it was apparently such an emergency visit that caused the fire, which occurred at 4:30 A.M. The previous day a doctor had

This report was prepared from data furnished by Mr. Clarence Heller (Member N.F.P.A.) and the Board of Fire Underwriters of the Pacific (Member N.F.P.A.).

The X-ray film viewing room in which fire originated. Part of wooden viewing cabinet, where fire is supposed to have originated, is shown on the floor. These cabinets were alongside of the two walls shown. Window frames were of metal with plain glass. Wooden filing cabinets, chairs, etc., were removed prior to taking this picture.

used the film examining room to view the negatives of a patient on whose case a consultation was being held at that time. Ten or twelve films were taken out for examination. He lighted one of the stereoscopes and he admits that when he left the room he forgot to turn off the current, which eventually ignited the film on the instrument. Fifteen or twenty other negatives had been left exposed on chairs adjacent to the stereoscope, and the lighted film is thought to have dropped on to these.

The fire was apparently discovered simultaneously by the night engineer and the telephone operator. The engineer had gone to the roof to start the ventilating fans, as was customary at that hour. Hearing a slight muffled explosion, he looked over the parapeted wall of the building on the street side and saw flames issuing from windows on the third floor. He immediately started for the nearest fire alarm box to call the fire department.

The telephone exchange of the hospital was directly across the hall from the room in which the fire started. When the telephone operator discovered the fire she sounded a general alarm throughout the building. Then she endeavored to leave her post, but there was so much smoke and flame in the corridor that she was unable to leave by that way, but jumped from the window of the telephone room to an area-way about 30 feet below, sustaining only a sprained ankle.

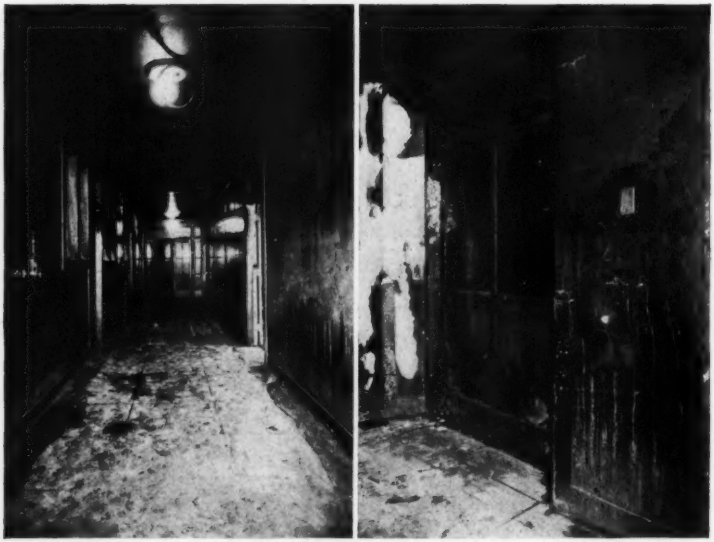
The contents of the room in which the fire occurred were almost entirely destroyed, including all films in the pigeonhole files. The furniture was badly

burned, but the cards in the record file suffered only scorching on the edges. The walls of the room were intact, although the so-called explosion threw some of the window sash into the street.

The effects of the fire in the corridor consisted of the burning of some wooden trim near the ceiling, for a distance of at least 50 ft. in both directions. Beyond this the walls and ceiling were coated with brown deposit, and still further on with soot. Linen fire hose in glass-covered recesses in wall was partly consumed, indicating that heat extended quite a distance along the fire-resistive corridor without fuel to feed on. The duration of the fire proper must have been a matter of a very few minutes. Except for the burning film and furniture in the room, the fire gave the fire fighters no great difficulty.

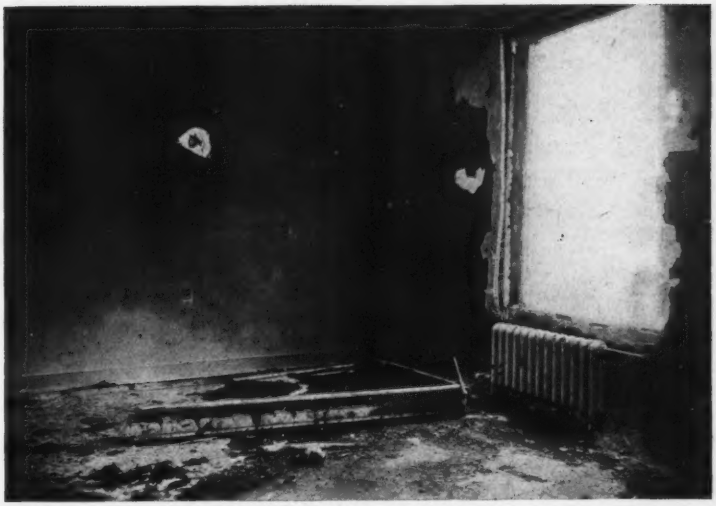
Travel of fire vertically from floor to floor was checked on the interior by metal covered wooden door frames with wire glass at stair and elevator openings. These doors also provided effective smoke stops. However, fire got into rooms on both fourth and fifth floors through the windows. Fire in these rooms was confined to wooden trim and possibly curtains.

The hospital was evacuated in fifteen minutes through excellent work on the part of nurses and employees, and patients were returned to their rooms in



Left: Effects of heat in corridor. First door on right is that of film viewing room, where fire started. First door on left that of telephone exchange, from which operator jumped out of window.

Right: Elevator entrance on the same corridor. A proper elevator shaft enclosure kept the fire from spreading upward at this point.



Room is on the next floor up, directly above the one in which the fire originated. This shows the effect of the lapping up of the flames. It was a private bedroom in which there was no patient at the time of the fire. Walls and ceiling are plaster on metal lath.

about forty minutes from time of alarm. The numerous ventilating fans were effective in removing a large part of the smoke in the building. The night engineer, in his haste to summon the fire department, forgot to start the fans, but they were started by the chief engineer a few minutes after the first alarm. The city fire department and employees coöperated splendidly in clearing away débris and getting quickly back to normal routine.

No apparent effect of smoke or fumes on persons exposed was observed after several days. This would point to completeness of combustion of the film, leaving no noxious gases, or to absorption of fumes by water from hose streams.

The loss was variously reported as amounting to from $50,000 to $150,000, but subsequent reports indicate that the total property damage will not exceed $15,000.

Airplane Fire Record.

The following is an analysis of 127 fires in airplanes which have been reported to the N.F.P.A. Department of Fire Record. One hundred and seventy lives were lost in these fires; of these fatalities 124 occurred during 1929. Fires in airplanes have been filed and classified since 1920, but over two-thirds of the fires in the present record occurred during 1929. A clipping service on airplane fires has been employed this year, which swells the number of available fire reports.

The newspaper reports, while manifestly incomplete in many important details, and no doubt frequently inaccurate, are the only records available. Care having been used in analyzing them, it is considered that they form a fairly satisfactory basis for the conclusions drawn herein. Furthermore, because the planes involved were frequently completely destroyed, more competent reports would probably not be obtained even after thorough investigation. In addition to the 127 fires above mentioned, there were 15 fires in airplanes in foreign countries. These were omitted as being too few in number to form an accurate basis for any conclusions about airplane hazards abroad, and because it was felt that their inclusion might be held by some to distort the picture of American flying conditions as reflected by the bulk of the fires in the record.

Classification by Type of Plane.

To group the fires according to types of planes which would be subject to approximately the same hazards of service, the following classifications were made:

EXPERIMENTAL PLANES. In this group were put experimental planes, new types, planes used in endurance, long distance, altitude and other test flights, racing planes and those used in exhibitions or contests. (13 fires.)

MILITARY PLANES. In this group were put 19 army and 5 navy planes. (Four of the army planes were being flown by reserve officers, the other 15 were in regular army service.)

AIR MAIL AND COMMERCIAL PLANES. Includes 15 air mail planes and 7 planes of commercial lines operating on a regular schedule. It is hard to separate these two types of plane because mail and passengers are frequently carried in the same plane.

PRIVATE PLANES. It is often difficult to say whether a plane is purely a private plane or whether it has a semi-public service character where it is used for giving "joy rides" or aerial taxi work. Of 68 planes in this group 28 were either strictly private planes or used for giving public rides. Fourteen of these were definitely known to be used for the latter purpose. Doubtless the other 14 were frequently so used also. Nine of the 68 were in training school use

(6 of them being flown by student pilots). Eight were in miscellaneous service, as manufacturers' demonstrators, rental planes, aerial photo or forest patrol work. On 23 there were no specific data except that the planes were obviously neither military, air mail nor air line planes. Two were known to be unlicensed planes, piloted in one case by an unlicensed pilot.

In addition to the above classifications it is necessary to study two distinct types of fires. These are (1) those starting in the air and (2) those which follow crashes. In the former the fire is the cause of any ensuing accident; in the latter the fire is the result of the crash. Obviously these must be separately studied. Crash fires are the most numerous, as indicated by the following table.

Fires in Airplanes.

Class	Fire Following Crash	Fire Starting in Air	Not Classifiable	Total
Experimental	7	6	0	13
Military	16	7	1	24
Air Mail and Commercial	15	6	1	22
Private	53	14	1	68
Total	91	33	3	127

It was not possible in every case to determine exactly whether the fire started in the air or on the ground following a crash. One fire, which properly goes in neither class, was the following:

January 11, 1929. A mail plane had been forced down by weather conditions near Vincennes, Ind. On starting the motor on the following day a spark is reported to have ignited the seven-passenger cabin plane, and it was completely destroyed in spite of belated efforts by a local fire department.

In another case a stolen airplane was set on fire when abandoned. The report on one crash of a naval plane does not specify whether fire occurred in the air or following a crash.

Fires Starting in the Air.

The following résumés of the fires starting in the air give the features of each fire on which data are available:

Experimental Class.

CHICAGO, OCTOBER 4, 1927. Wing broke and fire followed. Pilot killed. No data as to whether he had or could use parachute.

NEW CARLISLE, OHIO, JANUARY 26, 1929. On altitude flight pilot lost consciousness at 34,000 feet, but came to when plane had fallen to 10,000 feet at which point a fire started. Pilot leaped and landed with parachute safely.

ATLANTIC CITY, N. J., APRIL 6, 1929. Pilot landed plane and just got out and away when gas tank exploded. Fire apparatus arrived too late to attack fire successfully.

PECOS, TEXAS, AUGUST 22, 1929. Cigarette in pocket of spare flying suit. Woman pilot landed plane and put out fire with small hand extinguisher (probably tetrachloride type).

NEEDLES, CALIFORNIA, SEPTEMBER 2, 1929. Ship "exploded" in mid-aid. Pilot killed. Mechanic saved life with parachute.

GRINNELL, IOWA, OCTOBER 18, 1929. Monoplane in race caught fire in air. Pilot thought he had fire under control. Made forced landing. Fire broke out again. Pilot unsuccessfully tried to put out fire. No data as to how.

Military Class.

RANTOUL, ILL., OCTOBER 8, 1925. Plane took fire just off ground. Plane crashed, pilot killed; passenger, who jumped out, injured.

WASHINGTON, D. C., APRIL 6, 1928. Naval aviator, badly burned, landed safely with parachute. The plane had a "sprinkler" system, probably a tetrachloride system under pressure, piped to various parts of the engine compartment. No data as to whether this was used or not. Pilot probably did so, as he did not immediately leave the ship.

MITCHEL FIELD, L. I., MAY 25, 1929. Pilot made successful parachute jump, although 'chute harness caught momentarily on headrest.

MITCHEL FIELD, L. I., JUNE 28, 1929. Army observation plane took fire and pilot and passenger unsuccessfully fought flames with extinguishers (no detailed data). Passenger killed, pilot injured.

MT. CLEMENS, MICH., AUGUST 12, 1929. Pilot safely landed with parachute when ship caught fire. 'Chute harness caught momentarily on piece of control equipment.

MT. CLEMENS, MICH., NOVEMBER 14, 1929. Pilot landed plane from low altitude and put out fire with extinguisher.

GOODWATER, ALA., DECEMBER 4, 1929. Three of four fliers in all metal Curtiss transport twin-motored army plane who jumped with parachutes landed safely. Fourth killed when 'chute failed to open.

Air Mail and Commercial Class.

CHICAGO, AUGUST 31, 1920. Metal gas line broke under vibration and benzol ignited. Pilot shut off supply line and sideslipped plane. Fire died down, apparently when all benzol leaking was consumed. Ship was Junkers all metal and apparently not seriously damaged. Pilot burned.

TOLEDO, OHIO, JANUARY 16, 1929. Pilot made forced landing after unsuccessfully attacking fire with "chemical throwers." Pilot badly burned. Fire supposed to have started from open heaters on which mail sacks had been piled. (Tri-motored Ford.)

WALNUT, ILL., MARCH 22, 1929. Pilot of a Curtiss Falcon mail plane jumped with his parachute safely when his plane took fire, while lost in the fog. The plane and mail were destroyed in the crash.

ELKO, NEV., MAY 22, 1929. Seven passengers and two pilots made safe forced landing after port side motor took fire in air. Passengers gotten out safely, but plane destroyed. (Tri-motored Boeing mail plane.)

NEW YORK, N. Y., JUNE 7, 1929. Electrical storm set radio set afire. Apparently extinguished satisfactorily, but no data as to how. (Loening amphibian.)

RINGTOWN, PA., NOVEMBER 6, 1929. Pilot jumped in parachute after unsuccessfully using extinguisher (no detailed data). Landed near enough to plane to pull five of 18 mail bags to safety.

Private Class.

MARLBORO, MASS., AUG. 25, 1921. Plane caught fire in air, but pilot safely landed it and put out the fire. Passenger injured, pilot safe.

HATBORO, PA., APRIL 24, 1922. Pilot and passenger up for "joy ride" burned to death when plane took fire. Firemen arrived too late to effect any rescues, but put out the remaining fire.

LOS ANGELES, CALIF., MARCH 31, 1928. Plane took fire in air. Pilot and passenger burned beyond recognition. Plane destroyed.

OAKLAND, MISS., MARCH 8, 1929. Two killed in crash following fire in air.

KALAMAZOO, MICH., JUNE 2, 1929. Student pilot jumped from burning plane from 50 feet above ground and was killed.

ANATOL, N. J., JUNE 16, 1929. Pilot landed burning plane in forest and escaped himself, although plane was destroyed.

MEADOW, S. D., JULY 2, 1929. Fire believed to have started in spilled gasoline as ship had been refueled just before taking off with two passengers for a "joy ride." All three occupants burned to death before plane crashed.

WOODBRIDGE, N. J., JULY 12, 1929. Fire, starting in air, forced landing on golf links. Two occupants killed.

SAN BERNARDINO, CALIF., AUGUST 4, 1929. Explosion of gas tank in thunderstorm attributed to lightning. Pilot killed. (Plane was Lockheed.)

CASPER, WYO., AUGUST 8, 1929. Plane took fire in air during a night flight. The three occupants were killed in the ensuing crash.

ALLIANCE, OHIO, OCTOBER 12, 1929. Fire caused probably by faulty carburetor being tested. Pilot burned to death and plane demolished (Argo).

LAKE PROVIDENCE, LA., OCTOBER 13, 1929. Pilot at a private airport had taken two passengers for ride when fire took place. Unsuccessful attempt at forced landing, as two burned to death as plane fell and third shortly after crashing.

CLEVELAND, OHIO, NOVEMBER 22, 1929. Primer line broke, throwing gasoline on hot motor. Pilot, without parachute, made forced landing. Fire burned itself out apparently before serious damage occurred.

MIAMI, FLA., NOVEMBER 25, 1929. Pilot of Commandaire biplane died of burns received in pulling his companion out of wreckage after landing. Pilot was instructing passenger when fire started. Plane destroyed.

Loss of Life in Fires Starting in Air.

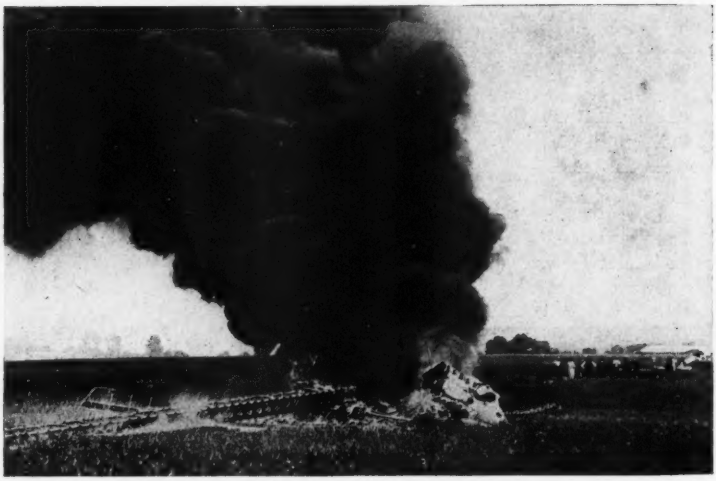
From the above list it will be noted that a very considerable number of fliers took to parachutes when their planes took fire. The following table throws some further light on parachutes as a factor in fires starting in the air.

Loss of Life in Fires Starting in Air.

Class of Service	No. Fires	No. Persons Involved	No. Killed	No. Fires Where Chutes Were Available	Lives Saved by Parachutes	No. Fires Where Chutes Not Available
Experimental	6	7	2	2	2	4
Military	7	12	3	7	6	0
Air Mail and Commercial	6	15	0	2	2	4
Private	14	26	21	0	0	14
Totals	33	60	26	11	10	22

In 11 of the 33 fires the fliers were known to have had parachutes and the 'chutes were successfully used in 8 of the 11. In one case the plane was struck by lightning and the pilot was killed by the ensuing explosion. His mechanic used his parachute successfully.

Where there were no parachutes, the planes were landed without loss of life in 9 cases, while there were 12 crashes and one "explosion" in the air in which the fliers were killed. Six of the 9 successful landings were in the experimental and air mail classes where skilled pilot may be assumed. In the private class only 3 successful forced landings were made following fires in the air, while 10 were fatal crashes.



International.

A typical crash fire. Note spectators in background, helpless without fire extinguishing equipment.

It is evident from reading the stories of the fires given above that in the case of private planes there were many losses of life which might have been prevented had the fliers had parachutes. Of course there are occasions, such as explosions in the air or when a plane is at a low altitude, when the use of 'chutes is not possible, but the experience of military flying as reflected in this fire record study plus the fact that in many of the fires cited ''chutes could have been used, leads to the conclusion that all fliers should be equipped with parachutes.

This is certainly the case in sport planes or those carrying few passengers. It has been argued that, in the case of passenger planes, especially those of all metal construction or multiple motors, the chances of the presumably skilled pilot to make a safe forced landing are better than those of the passengers, mostly unfamiliar with, and perhaps distrustful of parachutes, should they be confusedly bundled out of the cramped passenger quarters of the average passenger plane. In support of this, this record shows one fire in which the pilot safely landed eight passengers. The fire spread and destroyed the plane, but not until a safe landing had been made and the passengers evacuated. The fire in this case was in a side motor of the plane and the pilot by sideslipping kept the flames away from the passengers. However, in another case four men jumped from an army plane and three of them landed safely with 'chutes. There are no data regarding the fourth to tell whether the parachute failed or whether the flier did not pull his rip cord to release the 'chute.

In the majority of fires it was not possible from the reports to determine definitely whether or not the fliers had parachutes, but it is probable that they were mentioned in most cases where they were a factor. Three fires in military planes were included in the 11 fires mentioned, because it is a rule of army and navy service that 'chutes be worn. In one of these cases the pilot was able to safely land his plane. In another no attempt was made to use 'chutes, possibly because the plane was at a low altitude. Except for these cases, for all fires in which parachutes are not specifically mentioned, it has been assumed that none were available. In any case they were not used, and were therefore not a factor.

Parachutes showed up to best advantage in the military class, being used in 4 of the 7 fires in which they were available and saving 6 lives.

Crash Fires.

The crash fires proved very unsatisfactory from a fire record viewpoint, as available data as to the factors causing the crash were very meagre. In almost every case reported, the plane was destroyed and one or more of the occupants killed or burned or both. In only 11 of the 91 fires were there no fatalities. In two of the 91 cases the occupants jumped from the plane before it landed, being killed in the fall rather than the fire. Other than those cases the data did not establish definitely whether the fliers were killed by the crash or burned by the fire. It was, however, frequently obvious that but for the fire occupants might have been rescued. In 19 cases one or more occupants got out safely, although others were killed.

Below is a table summarizing the loss of life record of fires following crashes. This, together with an abridged record of each crash fire reported during 1929 (except a few which may have occurred in the last two weeks of December), will be here allowed to speak for itself.

Loss of Life in Crash Fires.

Class	No. of Fires	No. Fires Where There Were No Fatalities	No. Fatal Fires Where One or More Occupants Got Out Safely	Total Persons Involved	Total Killed	Per Cent Killed	Fatalities per Fire
Experimental	7	2	1	15	9	60	1.1
Military	16	2	4	32	24	75	1.5
Air Mail and Commercial	15	3	3	43	25	58	1.7
Private	53	4	11	118	96	81	1.8
Total	91	11	19	208	154	74	1.7

It should be borne in mind that the record here used may omit a number of crash fires where no one was seriously injured and which were not reported. This fact may somewhat swell the figures given in the above table for

"Per Cent Killed" and "Fatalities per Fire." It is felt that these figures measure, approximately, at least, the relative life hazard of military, commercial and private flying.

Crash Fires in 1929.

Experimental Class.

JUNE 23. Three men were burned to death when their plane, making an exhibition flight, crashed near Cincinnati, Ohio. The men were burned beyond recognition before rescuers with fire extinguishers could reach them.

JULY 8. A flier had been testing a new radio during a flight from Philadelphia to Washington. The plane apparently landed on a wing, which collapsed, crushing the gasoline tank. The pilot was killed.

NOVEMBER 27. A four motored Fokker transport plane, said to be the largest passenger land plane in America, took off on a test flight from Roosevelt Field, L. I., with three of its four motors running. Shortly after taking off another motor failed, apparently forcing an emergency landing. The plane crashed into two houses, setting fire to them. The two pilots were injured, but got clear before the fire assumed serious proportions.

DECEMBER 8. An endurance plane crashed and burned near Kissimmee, Florida, when forced to land in a fog because of fuel shortage. The occupants got out before the fire became serious.

DECEMBER 8. The refueling plane which was taking gasoline to the above endurance plane crashed on taking off, due to its heavy load and the poor visibility from the fog. The pilots were trapped in the cabin and burned to death.

DECEMBER 15. The president of an aircraft company was burned to death in a crash of a rebuilt plane which he was testing near Lincoln, Illinois.

Military Class.

JANUARY 6. The plane of two army fliers crashed and burned near Heathsville, Va.

MARCH 25. A plane taking off from the U. S. Naval Air Station at Pensacola telescoped another plane on the ground. Both immediately caught fire, blazing gasoline being spread all around. The two men in the plane on the ground burned to death. One of these may have been killed by the propeller of the ship which ran into them. The pilot of the falling ship was badly burned.

JUNE 8. A forced landing, apparently due to motor trouble, caused the gasoline tank of an army plane to "explode" near Langley Field, Va., which prevented would-be rescuers from getting the two occupants out of the wreckage. They burned to death.

JULY 8. Two army fliers crashed while landing at Fort Clayton, Canal Zone, following a training flight, and were burned to death.

JULY 10. Two army fliers were killed in the fire when their bomber crashed on Ford Island near Honolulu, as a result of motor failure during their takeoff.

SEPTEMBER 22. An army Lieutenant, taking off from the government airport near Fairfield, Ohio, crashed when his motor failed. His skull was fractured as he fell from the machine before it struck the ground.

OCTOBER 25. An air corps Lieutenant was killed when he jumped from his plane at a low altitude, when a forced landing in woods near Grantsville, Md., was made necessary by fog. Apparently he was too low to use the parachute successfully. The plane crashed and burned.

Air Mail and Commercial Class.

JANUARY 6. A mail plane crashed and burned when the pilot miscalculated a landing at Fort Crook Field, Omaha. The pilot was injured.

International.

Photograph taken practically at the moment of impact, with fire just starting. Fire occurring immediately after a crash makes rescue of the occupants well-nigh impossible.

JANUARY 6. An air mail plane crashed at night near Stafford Springs, Conn. The pilot is believed to have lost his way. The plane landed in a patch of woods and the pilot found pinned under the burning wreckage when rescuers arrived ten minutes after the crash. He was burned to death. Some of the mail was salvaged.

MARCH 30. A Fokker air transport crashed in the fog near Beaumont, California. The gasoline tank "exploded" and burned to death the pilot and three men passengers.

JUNE 24. A tri-motored Ford plane was taking off from the St. Paul, Minn., airport when its motors are reported to have suddenly stopped. The pilot attempted to bring the plane back to the flying field, but it scraped the tops of two houses and fell in a street. The pilot was burned in the crash, but seven passengers got out safely.

AUGUST 23. A monoplane carrying newspapers from Boston crashed in a forced landing near Lincoln, N. H. The pilot was forced down by bad air conditions over the White Mountains. The plane was destroyed in the fire following, but the pilot and a passenger escaped injury.

SEPTEMBER 7. A Fokker transport plane on the Albuquerque-Los Angeles line crashed against a mountain in a desolate section of New Mexico. When the wreck was found several days later all the eight passengers, seven men and one woman, were dead, killed by the crash or ensuing fire.

SEPTEMBER 17. A Boston-New York mail pilot was killed when, due to bad weather conditions, he crashed into Mt. Lamentation near Berlin, Conn. The plane took fire and plane, mail and pilot were destroyed.

OCTOBER 29. Bad weather conditions, rain and fog, plus night flying, caused the crash of a Cleveland-Louisville mail plane near Mt. Vernon, Ohio. The pilot was burned to death.

NOVEMBER 2. A Cincinnati-Chicago mail plane crashed in landing at night at Stout Field, Mars Hill, Indiana. The pilot was thrown clear by the crash, but the "explosion" of the gas tank showered him with blazing gasoline. He died while being taken to the hospital. Attendants at the field rushed to the crash with exinguishers, but were unable to control the fire.

DECEMBER 23. A Fairchild plane on the regular air line between Atlanta and Chicago crashed near Chattanooga, Tenn., killing four of the five passengers. One escaped before fire enveloped the plane. The plane had taken off from Chattanooga, but fell shortly after-

ward, apparently due to failure of a motor that had given trouble before it had left the field.

Private Class.

JANUARY 23. A passenger was burned to death and the pilot seriously injured when their plane crashed at the Jacksonville municipal airport and burst into flames.

MARCH 24. A light Waco plane apparently ran out of gasoline, forcing a landing in which the plane crashed and took fire. Three passengers, one a woman, burned to death.

MARCH 26. A flier took off in an old model biplane, but was forced back to the airport by motor trouble, when he crashed in landing and, fire following, he was burned to death.

APRIL 4. A plane hit a telephone wire at Khedive, Saskatchewan, smashed into a railway bunkhouse and burned. Both occupants were killed.

APRIL 29. Three young men who were reported to be partly intoxicated took up a plane from a Los Angeles airport and shortly later crashed. All were burned to death.

JUNE 1. Two fliers escaped death when their plane crashed into an electric power line near Lawton, Okla., while making a forced landing. The plane, thrown 150 feet, landed on its back. One wing of the plane burned from the contact with the wires.

JUNE 1. Two were killed when their plane crashed into an electric power line near Grand Island, Nebraska. Fire followed, either from contact with the line, or the crash itself.

JUNE 4. A pilot crashed and burned to death at the Oakland, California, airport.

JUNE 8. A plane said to be flown by an inexperienced pilot crashed near Detroit. Two passengers were burned to death and the pilot critically burned.

JUNE 15. One of the two occupants of a rented plane, which crashed and burned while taking off from a Memphis, Tenn., airport, was burned to death and the other burned seriously.

JUNE 24. The pilot of a plane crashing and burning near Creston, Iowa, was killed.

JUNE 30. So badly burned was a flier who crashed near Berlin, N. J., that his identity was established with difficulty.

JULY 1. Although two passengers were burned to death, the unlicensed pilot of an unlicensed plane which crashed near Sacramento, California, escaped with minor injuries. The rapid spread of the flames prevented his rescuing the passengers.

JULY 4. The pilot of a plane was pinned under the wreckage when it fell near Marshall, Missouri, and burned to death. The passenger, badly burned, managed to get out.

JULY 5. A ship apparently struck a ridge of trees in attempting to land near Stanford, Ky., and was hurtled to the bottom of a 75-foot cliff, where it burned with the pilot in it.

JULY 8. Two were killed in a crash fire near Montreal, P. Q.

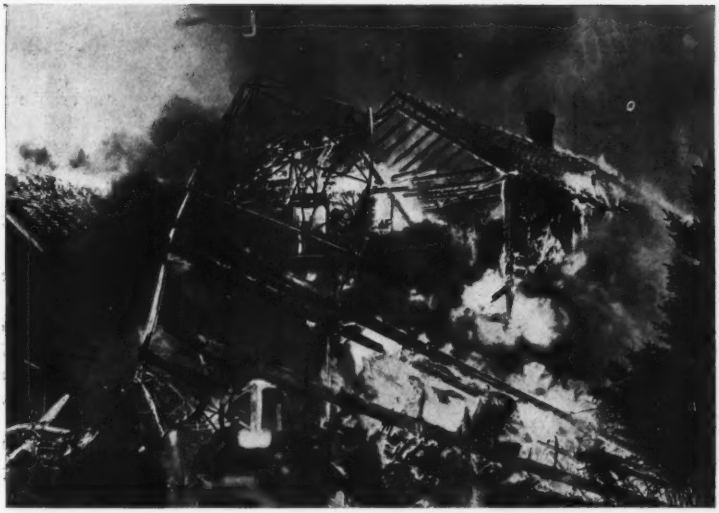
JULY 14. One of three fliers was burned to death when their plane crashed in the suburbs of Birmingham, Alabama. Two of the three got away from the fire.

JULY 20. Three were killed when their plane crashed in a field near Toledo, Ohio, and burned.

AUGUST 4. Two fliers were killed in the crash fire of their plane near Burlington, Iowa.

AUGUST 6. A rebuilt plane piloted by a young unlicensed pilot and powered with an obsolete type motor fell into a street in Cambellsville, Ky., killing him and his two passengers, when the wreckage took fire.

AUGUST 7. A plane crashed in an orchard near Westfield, N. Y., "exploding" as it hit the ground. The pilot got out safely, but a passenger was burned to a crisp.



International.

Crash of 4-motored 30-passenger transport plane near Roosevelt Field, New York. The plane crashed into a group of houses, setting fire to them. The two pilots were thrown clear and escaped with their lives.

AUGUST 25. A crash killed two passengers and seriously injured the pilot. One of those killed was killed by the crash itself and the other died of burns and injuries after being pulled from the plane by rescuers.

SEPTEMBER 1. A flier crashed near Mansfield, Mass., in a Great Lakes plane. The impact threw him on to the lower wing and burst the gasoline tank, throwing burning gasoline over him. He was fatally burned.

SEPTEMBER 2. A pilot with two women passengers had just taken off from a field near Westerly, R. I., when the motor failed. He attempted to turn back to the field, but the plane landed on a wing, throwing the pilot clear. Although hurt, he scrambled after the plane, which was skidding across the field. The plane took fire, however, before he could get the two women out. They burned to death.

SEPTEMBER 10. Two of three passengers in a forest patrol plane were burned to death in a crash fire near Lac du Bonnet, Manitoba. The third was injured.

SEPTEMBER 12. Three men on a pleasure trip in a plane crashed at Mills Field, San Francisco. The plane took fire on impact and all three were burned to death.

SEPTEMBER 14. Two men in a rented plane crashed at Berkeley, Calif., as a result of attempting a loop at low altitude. The plane landed on two houses and set them afire. Rescuers encountered difficulty in removing and identifying the victims.

SEPTEMBER 14. Six persons in a Travelair cabin monoplane were killed when the plane crashed near St. Catherine's, Ontario. The pilot was giving rides at an air celebration and apparently had to make a forced landing in a field. The plane struck a gully in landing, crashed and took fire. Police officers tried to put out the fire with water from a near-by stream and when the wreck was cooled removed the charred bodies.

SEPTEMBER 20. A flier was killed when his plane fell shortly after taking off from the Watson Airport near Cincinnati, Ohio. Fire followed the crash and the pilot was burned to death before rescuers got to him.

SEPTEMBER 21. Two men were killed when their Waco biplane crashed while attempting to land at the airport near Gilman, Ill. They crashed on the railroad tracks just north of the town and the ship blazed up. Rescuers used two small hand extinguishers unsuccessfully. It is reported both men were apparently killed by the crash itself.

OCTOBER 6. A "barnstorming" plane with two occupants crashed and burst into flames near O'Fallon, Ill. The pilot, taking off, saw that he would hit a telephone wire and tried to avoid it, but struck a pole. Neither occupant was seriously hurt.

OCTOBER 13. A flier from El Paso, Texas, was seriously burned when his plane overturned in landing at Camargo, Chihuahua.

OCTOBER 17. A Travelair plane with two occupants crashed following a forced landing near Muncie, Ind. The motor cut out, according to one of the victims of the crash, making a forced landing necessary. Fire immediately followed and an eyewitness helped one passenger, so badly burned that he later died, out of the wreck. The other had been stunned by the impact and was burned before the rescuers could get to him.

OCTOBER 27. A plane used to give "joy rides" to passengers crashed and burned while landing at a field near Flemingsburg, Ky. It struck a wire fence in landing. The pilot and a passenger jumped to safety before the ship took fire.

OCTOBER 28. Three fliers, one a woman, burned to death when their Travelair monoplane crashed near Eugene, Oregon. A farmer heard the plane's motor stop, after which a forced landing in a small field surrounded by trees was attempted.

NOVEMBER 5. Two men were killed at the Boston, Mass., airport when landing after an unsuccessful takeoff in a DeHaviland Moth. The pilot is believed to have been inexperienced. Not obtaining sufficient speed for the takeoff, he banked around to land again and crashed into an embankment. One of the forward struts pierced the gasoline tank, drenching the plane with blazing gasoline. Both men were burned to death. Fire apparatus could not arrive in time to be of assistance.

DECEMBER 8. A plane crashing at Stamford, Texas, and bursting into flames, fatally burned the pilot and a woman passenger.

Factors Causing Crash Fires.

Very little reliable information is available on the factors responsible for the crashes which resulted in fire. In 14 cases the crash came during takeoff or shortly thereafter, frequently after just getting off the ground and during attempts to reland. Eight crashes came during regular landings. The other 69 fires were in crashes due to forced landings of one kind or another. In only eight of these were there any data on why the forced landing was necessary, although it was frequently and indefinitely attributed to "motor trouble." In five of these eight cases bad weather conditions were cited, two were attributed to night flying conditions, and in one case to both bad weather and night flying.

Obviously motor failure forced the craft down in most cases, but data as to whether the failure was mechanical or due to fuel shortage or other factor were not given.

Causes of Airplane Fires.

In the case of crash fires there are no data as to what started the fire. The fire took place, however, due to the rupture of the fuel tank and it may be reasonably assumed that ignition came generally from hot exhaust stacks. (See "Studying Airplane Fires," QUARTERLY, July, 1928, Vol. 22, No. 1, page 70.) Causes of fires starting in the air are given below so far as they could be determined:

Cause	No. of Fires
Broken fuel line	2
Faulty carburetor	2
Lightning	2
Cigarette	1
Contact with high tension line	1
Spilled gasoline	1
Open heaters	1
Wing broke	1
Unknown	22
Total	33

Some slight additional light on the cause may be obtained from the following table of the part of ship in which the fire originated.

	No. of Fires
Motor compartment	9
Passenger cockpit	1
Radio set	1
Mail compartment	1
Side motor	1
Gasoline tank	1
No data	19
Total	33

Construction of Plane—Extent of Damage—Extinguishment.

Practically no data regarding the construction of the planes were available. In the case of nearly all planes, the destruction was complete. In two cases where the fire started in the air and successful landings were made, in one, the fire (in a small amount of fuel from a broken line), had burned itself out; in another the pilot put the fire out on landing. In only 5 of 33 fires starting in the air and in only one crash fire was the plane not completely destroyed.

In the case of fires starting in the air the preceding fire record notes the few attempts to use any available extinguishing apparatus. There was no case in the record where a fire was successfully controlled in the air, but in two cases it was put out after a landing had been made. Extinguishing equipment was generally lacking and that available was not always of sufficient capacity to control or retard the fire. The following table completes the data on these fires:

Fires Starting in the Air.

	Experimental	Military	Air Mail, Etc.	Private	Total
Forced landing, plane not damaged	1	1	2	1	5
Forced landing, plane burned up	3	2	2	12	19
Parachute used, plane abandoned	1	4	2	0	7
"Explosion" in air	1	0	0	1	2
Total	6	7	6	14	33

Carbon Dioxide—Fire Record.

Carbon dioxide has not as yet been in general use for fire extinguishment for a sufficiently long period to give any extensive fire experience, nor to permit statistical analysis of its efficiency as a fire extinguishing agent.

Carbon dioxide marine installations came into general use some time prior to the introduction of this type of equipment in buildings, and have given a good account of themselves in fire experience. Marine installations are not covered in the present record.

The fires reported to the N.F.P.A. Department of Fire Record to date are of interest in showing the current development in the use of this new form of fire protection. Actual fire experience, even though somewhat limited, furnishes the best criterion of performance and the best guide to proper practices. This record is accordingly presented not in any way as a final judgment on carbon dioxide equipment, but merely as a summary of the available reports which should be of value as a guide for the further application of this form of protection.

During the past year and a half the developments in the field have been rapid. For a general description of the principles of carbon dioxide fire extinguishment and a summary of developments up to that time, readers are referred to the article on Carbon Dioxide Fire Protection in the October, 1928, QUARTERLY, which has been reprinted in pamphlet form for convenient reference. Installation regulations for permanently piped carbon dioxide systems for the protection of special hazards were prepared by the N.F.P.A. Committee on Manufacturing Risks and Special Hazards last year and adopted by the Association at the 1929 Annual Meeting (Proceedings 1929, page 451). These regulations are now available in pamphlet form for general distribution. The installation and use of portable carbon dioxide extinguishers was covered by the Committee on Field Practice last year in their report, also adopted at the last annual meeting (Proceedings 1929, page 355). These rules will be found in the 1930 edition of the Regulations on First Aid Fire Appliances, now in course of publication.

The adoption of these regulations by the N.F.P.A., constituting the official recognition by the Association of this type of equipment, together with the listing by Underwriters' Laboratories of both fixed and portable carbon dioxide equipment, indicates that its value is fully established. Carbon dioxide is particularly desirable for the extinguishment of certain types of fires, especially those where its smothering effect can be fully utilized and where the type of fire or other condition involves some objection to the use of other methods of fire extinguishment. Like other fire extinguishing agents, however,

carbon dioxide to be successful must be correctly applied and cannot be relied upon when used on types of fires for which it is not suited, or under other unfavorable conditions. In the following summaries of individual fires the experience for the most part has been successful; the few failures reported being clearly chargeable merely to incorrect applications of carbon dioxide. Where there has been any question as to the value of carbon dioxide the fire is reported in greater detail, not with any thought of emphasizing these isolated cases, but in order to explain the circumstances fully and point the way towards the correction of defects in future installations.

The following summaries cover all the fires (subject to the exceptions noted below) where carbon dioxide has been used that have been reported to the N.F.P.A. Department of Fire Record to December 15, 1929. Only fires have been included where the exact date, place and other significant details are available, and where the information has been verified through authoritative sources.

The use of carbon dioxide by public fire departments is separately treated in the articles on the experience with this type of equipment in the Los Angeles and Boston fire departments, which are printed on pages 283 and 287.

Fixed Systems Protecting Flammable Liquid or Vapor Hazards—Successful Operation.

The following summaries of nine fires in which fixed carbon dioxide fire extinguishing systems have operated successfully show clearly the value of this form of protection for special hazards.

SEPT. 17, 1926. LINOLEUM WORKS, LANCASTER, PA. Fire occurred in a room used for linseed oil boiling and naphtha storage. The fire was due to the overheating of the oil during the boiling operation. The fire was promptly extinguished without appreciable loss by the manual operation of a room-flooding system.

DEC. 22, 1926. DRY CLEANING PLANT, MALDEN, MASS. Fire in one compartment of a naphtha house was promptly extinguished without damage by the manual operation of a room-flooding system.

APRIL 23, 1927. DRY CLEANING PLANT, MALDEN, MASS. Fire in dry cleaning washer room was promptly extinguished without damage by the manual operation of a room-flooding system.

OCT. 1, 1927. CELLOPHANE MANUFACTURING PLANT, BUFFALO, N. Y. Fire promptly extinguished by the manual operation of a room-flooding system. Production was resumed immediately after fire was extinguished.

SEPT. 22, 1928. AUTOMOBILE SPRING FACTORY, DETROIT, MICH. The process involved in this fire was the finishing of spring seats, which are hung from a continuous conveyor chain passing through an enamel dipping tank and drying oven. Fire started in the oven and extended to the drain board before discovery. A carbon dioxide system protecting the oven was manually

operated and the fire extinguished in the oven. The carbon dioxide system did not extend to the dip tank and drain board, these being protected by an automatic foam equipment. The carbon dioxide gas escaping from the oven was, however, sufficient to reduce the temperature around the heat actuating device controlling the release of foam on the drain board. The foam equipment was manually operated and the fire extinguished.

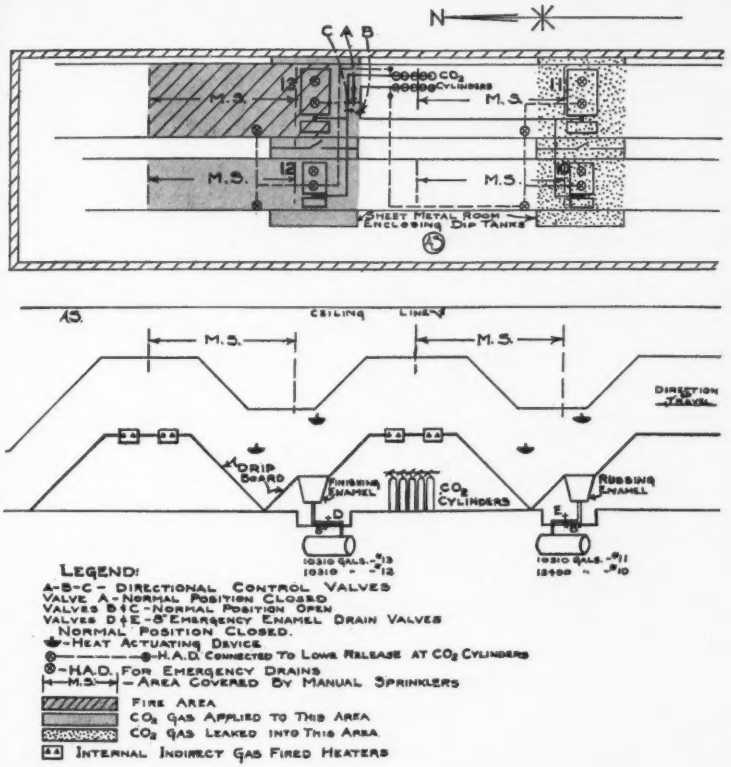
JAN. 30, 1929. AUTOMOBILE FACTORY, DETROIT, MICH. Fire occurred in a wooden roof structure housing oil-burning heating equipment for ovens. A room-flooding system operated automatically and controlled the fire.

FEB. 27, 1929. AUTOMOBILE FACTORY, WALKERVILLE, ONT. The process involved in this fire consists of two rooms and ovens in which fenders are hand dipped, drained and baked. Portions of the partitions enclosing the dipping process are of ordinary glass. The ovens are of the box type. On February 27, about 9 A.M., an explosion occurred in the second coat oven, bulging the sides of the oven, blowing the doors open and breaking about eighty per cent of the glass in the partitions enclosing the second coat dip room. A small fire started in the oven, but was not severe enough to ignite the drain board or operate the automatic carbon dioxide system. The fire was immediately extinguished by portable equipment.

Less than a minute later a more violent explosion occurred in the first coat oven. This explosion likewise bulged the sides of the oven, blew open the doors and broke a large portion of the glass in the partition enclosing the first coat dip room. A fire started on one corner of the drain board. This was promptly extinguished by the automatic operation of the carbon dioxide system. The fire did not extend to the dip room. The carbon dioxide equipment operated satisfactorily, the gas used for heating the oven being shut off and the covers of the dip tanks being automatically dropped. The occupants of the space which was flooded were in no way endangered by the release of gas and were able to vacate the space uninjured by the extinguishing agent.

MAY 16, 1929. AUTOMOBILE FACTORY, LANSING, MICH. Fire from unknown cause in a fender enameling process was promptly extinguished by the automatic operation of carbon dioxide equipment with a loss estimated at less than $200. The accompanying diagram shows the arrangement of the dip tanks and ovens involved. In addition to carbon dioxide, manually controlled open sprinklers protect the ovens, and the area outside the ovens has automatic sprinkler protection.

The gas cylinders are arranged in two batteries of 38 cylinders each, and so piped that Sections 12 and 13 are covered by one battery and Sections 10 and 11 by the other. Whichever battery is not automatically tripped by fire operating the heat actuating devices located in the section it protects, serves as a reserve, and if the first gas release is found to be not sufficient to extinguish the fire, can by means of the directional valves, A, B or C, be manually



directed to the desired section. The carbon dioxide outlets are located at the bottom of the dip tanks.

The fire in Section No. 13 was completely extinguished by the rush of gas from the affected battery of cylinders. The heat actuating and release devices operated without fault and released the gas and opened the 8-inch emergency drain. The apparatus automatically shut off the oven burners and stopped the conveyor chains.

Enamel was spattered out of the dip tank in No. 13 on to the walls. Section No. 12 dip tank did not overflow because the tank was only about half full of enamel. This oven was not in use at the time of the fire. Considerable enamel overflowed out of the tank in Section No. 11, the amount spilled out on the floor here being much more than was spattered in No. 13, probably due to the fact that the automatic drain valve functioned in Section No. 13, caused by the presence of fire, and did not function in Section No. 11

because no fire was present. All of these dip tanks are provided with separate automatic drain valves and separate emergency drain tanks.

This fire clearly demonstrates the effectiveness of carbon dioxide for extinguishing fire in confined spaces. The spattering of the enamel might have been avoided by a higher freeboard on the tanks, by a standard arrangement of submerged orifices, or by an installation of nozzles above the surface rather than sub-surface piping. The difficulty with the directional valves could be corrected by an improved design, or by an installation so arranged as to make directional valves unnecessary.

JULY 2, 1929. WAX MANUFACTURING PLANT, RACINE, WIS. Fire started under a platform in the wax mixing room, where wax and flammable solvents are mixed. The automatic operation of a carbon dioxide flooding system extinguished the fire with negligible damage. Production was resumed immediately after the fire was extinguished.

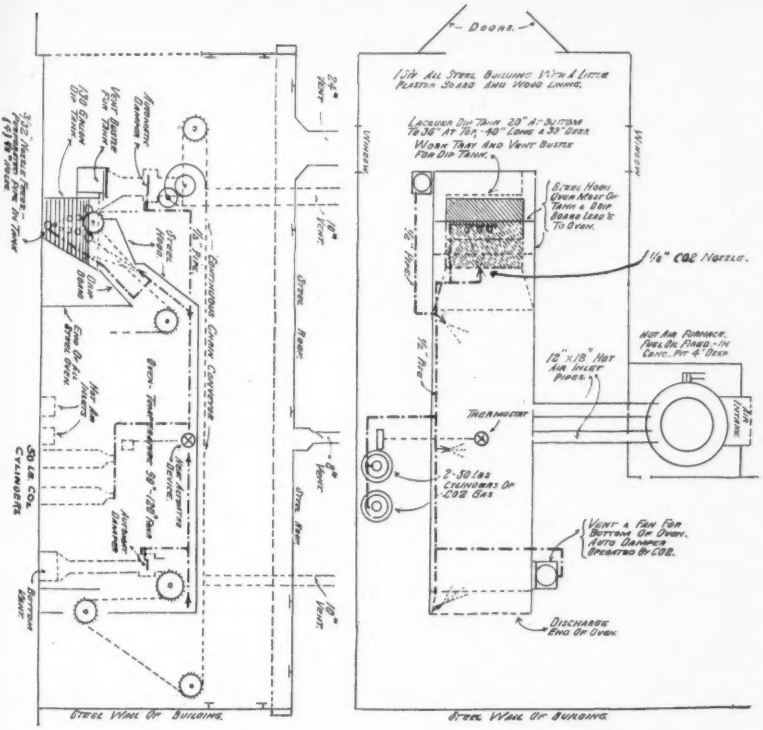
Fixed Systems Protecting Flammable Liquid or Vapor Hazards—Improper or Unsuccessful Operation.

JAN. 4, 1929. DROP FORGE TOOL WORKS, BUFFALO, N. Y. This fire occurred in a continuous lacquer dipping and drying system for finishing automobile cranks, located in a small detached steel building, lined in part with plaster board and with a small area of wood wainscotting. The arrangement is shown by the accompanying sketch, which gives a plan and section of the building.

Heat for the oven is supplied by an ordinary household type hot-air furnace, oil fired. It was the duty of the night watchman to start this furnace about 5 A.M., preparatory to the day's operations. On the morning of the fire it appears that the furnace was started much earlier, with the result that the furnace overheated. The day force, arriving at 7 A.M., found the building full of smoke, and at once shut the furnace down. The oil valve was probably only partly shut, thus permitting oil to spill into the furnace pit. Ten minutes later the furnace was again started, but as the foreman decided there was insufficient stock to run a half day, he ordered the furnace shut down. Fire was then discovered in the concrete pit and air chamber of furnace. Flames passed through hot air ducts to the oven and ignited the lacquer in tank.

The carbon dioxide equipment operated automatically. It not only failed to extinguish the fire, but made it more intense and caused its spread to the wood interior finish of the building. The failure was probably due to a high velocity jet of carbon dioxide gas coming down on the surface of the lacquer at a 60 degree angle from a distance of 34 inches. This blew against bubbles of lacquer produced by the discharge from perforated pipes in the bottom of the dip tank, thus splashing the lacquer out of the tank.

The fire was extinguished by the fire department, using two 1-inch hose lines, after the fire had been burning ten or twelve minutes and most of the


Doors
1/2" All Steel Building With A Little Plaster Board And Wood Lining.
Lacquer Dip Tank 20" At Bottom 16 3/8" At Top 40" Long & 33" Deep
Work Tray And Vent Duster For Dip Tank.
8 Steel Hood Over Neck Of Tank & Bair Board Lead To Oven.
1/16" CO2 Nozzle.
Hot Air Furnace, Fuel Oil Fired - In Cent. Pit & Oven
12" x 18" Hot Air Inlet Pipes
Thermostat
2-50 lbs Cylinders Of CO2 Gas
Vent A Fan For Bottom Of Oven. Auto Damper Operated By CO2.
Discharge End Of Oven
Steel Wall Of Building
Steel Wall Of Building
Steel Rack
Steel Rack
Steel Pipe
Automatic Damper
Work Tray Over Dip Tank
120 Gallon Dip Tank
Dip Board
Electrical Chain Conveyor
Brick Thermometer 90°-120° Fahr
Hot Air Ducts
Fan Bottom Vent
50 lb. CO2 Cylinders
Bottom Vent

thinner or solvent had been burned out of the liquid dip. The loss was between $2000 and $2500.

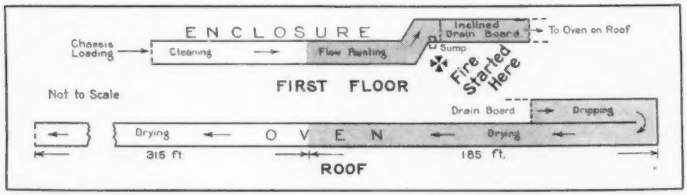
Subsequent to the fire a test was made in the same building duplicating as far as possible the conditions of the fire, the reasons for the failure of the equipment being verified. The installation was accordingly redesigned, eliminating the nozzle discharging down upon the surface of the dip tank, and substituting for sub-surface discharge, low velocity nozzles above the surface of the dip tank. A further test indicated that the redesigned equipment could be relied upon for any fire originating in the dip tank or oven. This fire emphasizes the importance of having all details of an installation comply with the standard requirements.

SEPT. 15, 1929. AUTOMOBILE FRAME MANUFACTURE, CLEVELAND, O. In this plant automobile chassis frames are hung on a conveyor, cleaned, and flow-painted in a sheet-metal enclosure in a one-story unsprinklered non-

combustible building. The conveyor then ascends over an inclined drain-board into the dripping section of an insulated sheet-metal oven on the roof. The conveyor then swings back into the adjoining section of the oven, which extends 500 feet along the roof.

On Saturday evening, September 14, this large oven was shut down for the week end. Paint drippings on the drain-board and just inside the oven entrance were not cleaned up. Just outside the painting enclosure on the first floor were standing several kerosene and varnolene barrels. It was here in the open that the paint was mixed, and considerable paint had been spilled on the floor.

On Sunday morning two watchmen were on duty at the plant. A few contractor's men also were installing a new oven on a concrete platform just outside the building. They were using an acetylene cutting torch. As a precaution, they had hung a canvas tarpaulin which, however, only partially shielded an open window into the building. A spark from the torch passed through the window and ignited the paint. Since there were no sprinklers in the building, fire quickly spread to the kerosene and varnolene barrels stored just inside the window. It also passed through untrapped pipes to a loosely covered tank containing about ten barrels of paint, and to an open sump extending under the oven wall at the foot of the drain-board. There was ample fuel for a long, hot fire.



Factory Mutual Record.

Plan of painting enclosure and oven. Shading shows hazardous portions of enclosure and oven equipped with carbon dioxide flooding system.

A carbon dioxide flooding system protected the flow-painting section of the enclosure and the dripping section of the oven for a distance of 370 feet. The remainder of the oven and enclosure contained nothing to burn and therefore had no protection. The carbon dioxide was in three banks of cylinders, each containing nineteen 50-pound cylinders, arranged for automatic or manual operation and piped to nozzles in the oven.

One of the contractor's men quickly pulled the manual controls on the carbon dioxide equipment, turning gas into the oven and enclosure. This for a time prevented any of the outside fire getting a foothold inside. Gradually, however, the carbon dioxide leaked out through flues, spread out into the other section of the oven, and became reduced in concentration, so that the

Factory Mutual Record.

Fire started near present position of wheelbarrows and spread through open sump into flow-painting section of enclosure formerly supported on the steel columns.

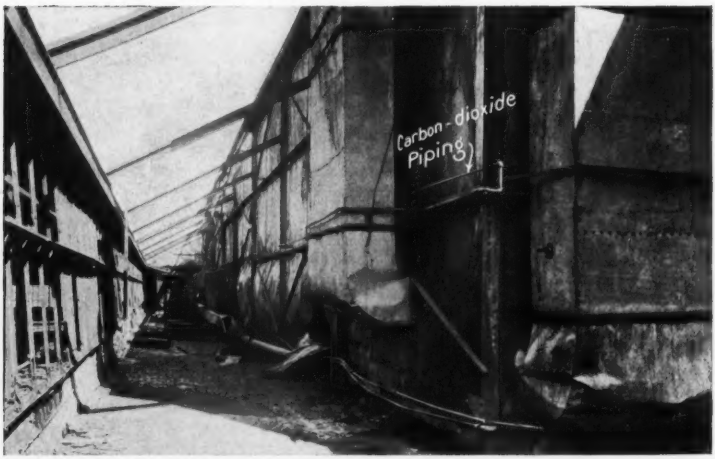
fire entered from outside through the open drain-board sump into the flow-painting section.

The public fire department had been called by one of the watchmen, and on arrival used five large hose streams and two 40-gallon foam engines. Meanwhile the fire on the drain-board and in the painting section of the oven was raging fiercely, feeding on the paint drippings. Because there were no openings in the side of the oven, hose streams could not be used effectively, and the fire continued to burn with great heat for three hours, until the drippings were almost entirely consumed. All the fire was in the first story, along the inclined drip-board, and just inside the entrance of the oven, but nevertheless the intense heat spread several hundred feet down the oven and was there con-

Factory Mutual Record.

Inside the oven. Dripping section near head of incline at left. Accumulated drippings on floor here and in first story furnished fuel for a prolonged fire.

Two hundred feet from the flames. There was no fire here, but the heat from the fire in the dripping section, confined by the oven walls, distorted the steelwork as shown.



Factory Mutual Record.

Dripping section on roof near head of incline from flow painting in first story.

fined, so that in the absence of cooling water from sprinklers or hose streams the steel frame and sheet metal walls were badly distorted. The loss is estimated to be between $100,000 and $125,000.

The oven was installed less than two years ago. At that time it was recommended that automatic foam protection and open sprinklers be installed in the oven, automatic sprinklers outside the oven over the paint mixing, and doorways in the walls of the oven itself so that hose streams could be used inside. Later the carbon dioxide protection was accepted for the oven itself, but the automatic sprinklers recommended outside were not installed. They should have been provided and would have controlled the fire so that it would not have continued long and intensely, later spreading inside the oven as the effect of the carbon dioxide was dissipated.

This fire is not to be construed as a failure of carbon dioxide, since if the fire had originated inside the oven it probably would have been extinguished. It does, however, show that the effectiveness of the carbon dioxide, unless confined, does not last. It is, therefore, advisable, where carbon dioxide is installed to avoid damage to expensive japans and enamels, also to provide open sprinklers as a second line of defense in case the fire persists beyond the limited time during which the gas is effective.

Automatic foam protection and open sprinklers are effective over a long period of time. If installed in this oven they no doubt would have prevented appreciable damage. They cause some damage to dipping liquids, but this should be no objection where the quantity and value of the paint which might be spoiled is relatively small, as in this case.

OCT. 8, 1929. AUTOMOBILE FACTORY, RACINE, WIS. The processes protected are a dip tank and conveyor oven similar to the processes involved in fires described above. The fire was discovered by an employee in an electric pull box on the side of the oven, due to a short circuit in the wiring supplying the ventilating and heating equipment. The employee disconnected the main switch, but the fire in the pull box continued. He then pulled the cable releasing a battery of thirty-one cylinders of carbon dioxide, which discharged into the No. 1 dipping and baking section, spotting about one hundred and ten fenders and frames in process due to sudden cooling. In the meantime the city fire department had been called and on arrival extinguished the fire in the pull box by means of a carbon tetrachloride extinguisher.

The operation of the carbon dioxide extinguishing system in this case was due to a lack of understanding, on the part of the operator, of the intended function of the system. The fire in question should have been handled by a portable extinguisher and the carbon dioxide protection used only in case the fire extended to the dip tank and oven.

Portable Equipment Used on Flammable Liquid or Vapor Hazards in Buildings.

Seven fires are recorded in this classification which show uniformly successful results. The number of fires recorded here is not sufficient to draw conclusions as to the merit of such equipment, except to observe that when intelligently applied upon the type of fire for which it is suited good results may be expected. Portable fire equipment of any type, particularly when in the hands of persons untrained in its use, cannot be expected to show an efficiency of one hundred per cent. In the seven fires recorded sufficient detail is not available to call for individual accounts of the several fires, which are summarized as follows:

Varnish Kettle Fires extinguished after other means had failed (2).
Resin Kettle Fire (1).
Gasoline cleaning in plant manufacturing airplane engines (1).
Pail of gasoline ignited in police headquarters (1).
Carbon bisulphide tank (1).
Lacquer fire (1).

Electrical Equipment Protected by Permanent Installations.

MARCH, 1929. AUTOMATIC ELECTRIC SUB-STATION, FLORENCE, ALA. Lightning entered the station and set fire to transformers. A carbon dioxide flooding system, operated by the melting of a fusible link, functioned efficiently and confined the loss to less than $100. A similar fire in a sub-station at this location, about five years earlier, not equipped with carbon dioxide, resulted in a total loss of building and contents.

JULY 24, 1929. ELECTRIC POWER STATION, WASHINGTON, D. C. On July 23 a 15,000 KW. frequency charger set of the induction type was started for the first time. The machine had been running for about 24 hours when the rotor winding broke down and fire started in the machine. The machine was cleared from the 25 and 60 cycle buses by the operation of rotor ground relay, and carbon dioxide was discharged into the machine through the operation of the thermal relays in the air duct. Fire was immediately extinguished, but all cylinders were permitted to discharge to prevent any possibility of re-ignition. While the fire was extinguished, the winding of the machine was completely destroyed, due to the fact that the binding wire at one end of the armature came off and wedged in the air gap.

Portable Extinguishers Used on Electrical Equipment.

NOV. 14, 1927. CORK WORKS, BROOKLYN, N. Y. Fire in armature of motor extinguished with portable carbon dioxide extinguisher.

JULY, 1928. METAL REFINING WORKS, CATARET, N. J. Fire in a large electric generating set was extinguished with portable carbon dioxide extinguisher.

DEC. 12, 1928. ELECTRIC RAILWAY SUBSTATION. A short circuit started a fire in a synchronous converter. Fire was at once extinguished by the use of a portable carbon dioxide extinguisher, the only damage being that caused by the initial short circuit.

JAN. 10, 1929. ELECTRIC MANUFACTURING PLANT, HAMILTON, ONT. After a 15,000 KVA transformer had been completed and the tank filled with oil it was discovered that the insulation contained an excessive amount of moisture. The oil was drawn off and hot air blown through the transformer for about three weeks. The transformer was then sealed up and a twenty-seven-inch vacuum maintained in the case for a week. During a part of this period a small current was passed through some of the windings. The manhole cover was then removed and the insulation on the coils burst into flames. The cover was replaced, the vacuum pump started again, and for about two hours, when a fair vacuum was obtained, carbon dioxide was discharged into the tank. After four days the transformer was dismantled. The insulation on two sections of the windings was completely burned off and other coils more or less damaged from smoke and heat. There was no damage except to the coils.

APRIL 22, 1929. ELECTRIC SUBSTATION, BOSTON, MASS. Fire occurred in a 13,000-ampere rotary converter due to a ground in the machine. The machine was taken out of service at once and several carbon tetrachloride extinguishers used without apparent effect. A fifty-pound carbon dioxide extinguisher was then applied, which extinguished the fire by the time the machine had stopped turning. The loss was estimated at from $1500 to $1800.

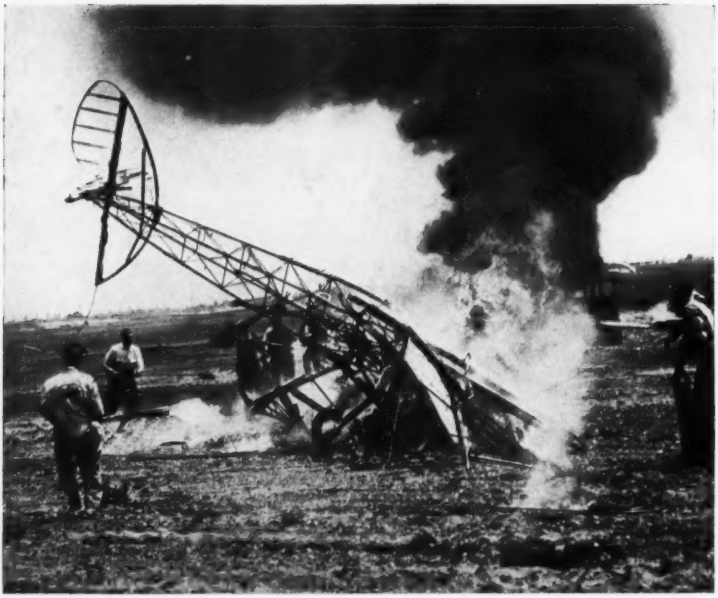
Airplane and Automobile Fires.

Carbon dioxide equipment is at an inherent disadvantage on fires in the open air, where there is nothing to confine the gas and its smothering effect may be largely lost. When such fires are attacked in their incipiency with a discharge of carbon dioxide sufficiently large in proportion to the size and character of the fire, successful results may be obtained, but not otherwise.

DEC. 3, 1927. AUTOMOBILE FILLING STATION, FREEPORT, N. Y. Automobile gasoline tank overflowed and gasoline ignited. The fire was promptly extinguished with a portable carbon dioxide extinguisher.

JULY 21, 1928. AUTOMOBILE BUS, BROOKLYN, N. Y. Parked bus caught fire and was burning vigorously when attacked with a portable carbon dioxide extinguisher. The fire was promptly extinguished and the bus saved.

JUNE 26, 1929. AIRPLANE, ROOSEVELT FIELD, NEW YORK. A plane with two passengers had just taken off when its motor failed. The plane crashed and burst into flames. One man was thrown clear, but his clothing was ignited by burning gasoline and he was fatally burned. The other man was trapped in the blazing plane, it was reported, held by his safety belt. Though conscious for some moments he could not be reached, and was burned alive. The



International.

Airplane fire at Roosevelt Field, New York, in which two lives were lost.

accompanying photograph shows the use of hand carbon dioxide extinguishers on this fire, the photograph constituting the only positive evidence of this use of carbon dioxide. It appears from the picture that these extinguishers had insufficient capacity to be effective on such a fire, and that by the time they were used hope for saving the lives of the men imprisoned in the wreckage was already gone.

It is thought that if carbon dioxide in large quantity could be used sufficiently promptly on a fire of this character, persons in the wreckage might be released under the protection of the discharge, even though the fire subsequently rekindled.

OCT., 1929. AUTOMOBILE GASOLINE TRUCK, SAN DIEGO, CAL. A tank truck carrying 500 gallons of aviation gasoline took fire between Marine Corps hangars at the Naval Air Station as a result of a back-fire in the carburetor. The force of the explosion was sufficient to carry away the gasoline line at the carburetor; with this flow of gasoline the fire assumed dangerous proportions. Soda acid, foam and carbon tetrachloride extinguishers and sand were used in an unsuccessful attempt to extinguish the fire in the flowing gasoline. Two carbon dioxide extinguishers were then used, which promptly extinguished the fire.

Motion Picture Film Fires.

The N.F.P.A. Committee on Hazardous Chemicals and Explosives does not regard carbon dioxide as a suitable extinguishing medium for fires involving more than small quantities of nitrocellulose motion picture film or similar materials, as the cooling effect of water is considered essential.

Two fires in motion picture film are reported from Los Angeles (March 28 and July 15, 1929), in which carbon dioxide extinguishers were successful. This is presumably due to the exceedingly prompt application of the carbon dioxide before the fires had been burning long enough to heat any material quantity of the film to its decomposition temperature.

A fire in an experimental television studio in Pittsburgh (Sept. 8, 1929), where film was ignited by heat from an electric arc, was not controlled by a carbon dioxide extinguisher used by the operator. The fire quickly extended to the interior of film containers, where it could not be reached by the carbon dioxide. The fire lasted only two or three minutes, but gave off sufficient heat to open two automatic sprinkler heads. Loss estimated at approximately $10,000.

Miscellaneous Fires.

The following miscellaneous fires are reported as successfully extinguished by portable carbon dioxide equipment: manhole fire, fire in oily dust on ceiling of engine room of large office building, two fires in grease in a hotel kitchen, where food being cooked at time was not lost, fire in booth containing fireworks at fair (fire extinguished before fireworks became involved).

In addition to the preceding record a number of interesting fires are referred to in the following accounts of the experiences of the Los Angeles and Boston fire departments.

Los Angeles Fire Department—CO_2 Equipment.

By Ralph J. Scott, Chief Engineer,
Los Angeles Fire Department (Member N.F.P.A.).

In the Los Angeles Fire Department, acting under official order, officers have made use of carbon dioxide at a great many fires of all types, even when such officers knew that water, carbon tetrachloride, foam or chemical extinguishers would have done the work just as well and at less cost. We believe that the experience thus gained has been worth the expense incidental thereto. This order also provides that a separate and specific report be made of each instance of use. As a result, we have a great number of reports covering a large variety of fires. I may state here that the general tenor of the reports shows approval of the officers after actual observation of the results obtained.

Several hundred of these extinguishers are carried on apparatus of this department. Each engine carries one twenty-pound extinguisher, and each chief's car carries one seven and one-half pound extinguisher. Our experience

thus far is concerned with these hand extinguishers principally, as the CO_2 wagon, later referred to, has not as yet been called into service at an actual fire.

When a fire has gained considerable headway and burning materials are heated to the ignition point, an inordinate quantity of carbon dioxide gas will probably be necessary to control the fire if dependence is placed upon this agent alone. Although the expanding gas creates a temperature of approximately 110 degrees below zero Fahrenheit, the effect of this cooling upon the heated materials is not apparent, and is actually much less than when water is used; hence it has been our experience that re-ignition is especially liable to take place. Therefore, the use of carbon dioxide is specially indicated in the case of flash fires. Its extinguishing effect upon such fires is practically instantaneous. If the fire has been burning for some time resort to water to cool the superheated materials, after the flame has been extinguished, will probably be necessary, owing to the liability of re-ignition. This brings about a condition of danger to firemen unless they are forewarned by experience and instruction. In most cases the gas will subdue the flames as if by magic. If the fire has made some headway, re-ignition is almost sure to take place as soon as sufficient oxygen replaces the gas used; hence it is well to know that at all fires where carbon dioxide is used as the extinguishing agent there is danger of a re-flash or an explosion, where volatile liquids, illuminating gas, etc., are involved, and that precautions must be taken to prevent this occurring; also that all persons must be cautioned against investigation or overhauling operations until the heat is reduced below the ignition point.* The following two cases, typical of many on record, will illustrate this point.

On May 1, 1929, Hose Company No. 2 responded to an alarm at No. 6315 Hollywood Blvd. A large roast of meat had been left cooking in a gas stove oven. The roast pan containing approximately one gallon of fat and grease had taken fire, due to the stove being overheated. The flame was extinguished five times, and it re-flashed a like number of times until a hand water pump was used to cool the oven and contents below flash point.

On July 21, 1929, at No. 1749½ North Western Ave., a woman was seriously burned when gasoline in which she was cleaning clothes ignited. CO_2 was used, which almost instantly extinguished the flaming tub, pan and bucket of gasoline. Two minutes later the gasoline re-flashed, but fortunately no one was near it.

Having in mind the hazard to human life which such a condition brings about, a bulletin of warning was issued from Fire Department Headquarters for the information of our members, reading as follows:

> Owing to the quick action of carbon dioxide gas in extinguishing flame, the temperature of the burned mass is generally left many degrees above the ignition point, which makes the danger of a re-flash or explosion very evident.
>
> Officers should take every precaution to prevent an accident which may result fatally to members of the department or civilians, if allowed to enter or advance among the fumes from volatile liquids, illuminating gas, gasoline, etc., where it has

*Continuing the discharge after the fire is extinguished until the gas is exhausted, and thus coating the burned substance with carbon dioxide snow, will materially decrease the danger of re-flash.—Ed.

been spilled or stored in large quantities, and the flame just extinguished with carbon dioxide, as the gases may build up and explode or re-flash from the superheated material or containers, such as drums, vats, tanks, etc., that were subject to the flame.

Ventilation should be quick and thorough, and the surrounding materials cooled beyond any chance of a re-flash before anyone is allowed to overhaul the materials involved.

Carbon dioxide gas is almost instant in its action and a great deal faster than any extinguisher we have been accustomed to use in extinguishing flame. It excludes the oxygen, and the flame is snuffed out, leaving the superheated mass or fumes ready to re-flash or ignite and explode as soon as the gas from the extinguisher has been displaced by fresh oxygen, which may be fatal to any who may have exposed himself to this danger.

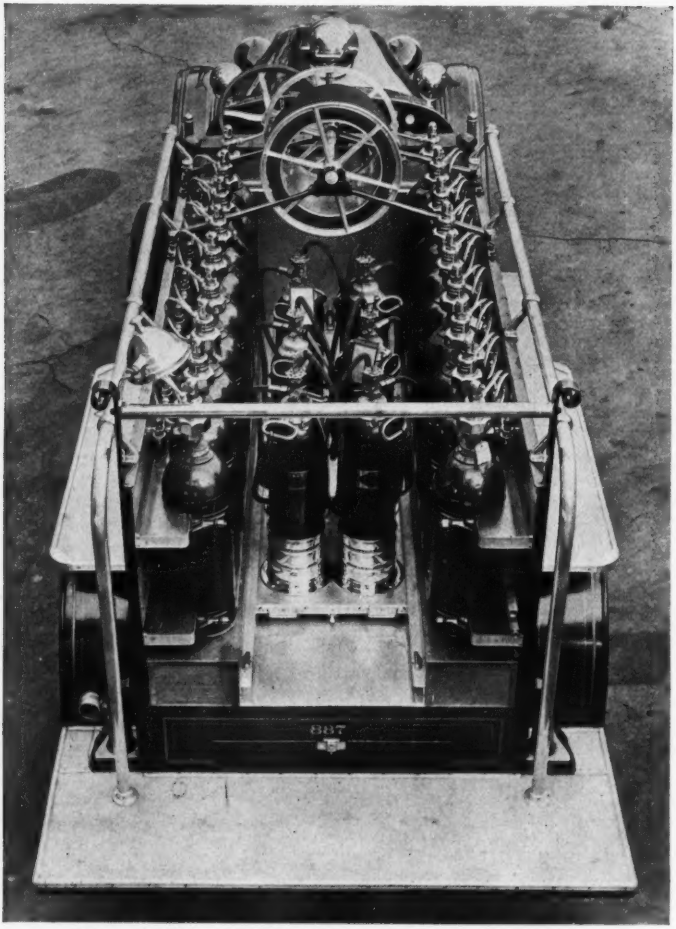
Officers should use judgment when carbon dioxide is used as the extinguishing agent where explosive gases or volatile liquids are involved.

The normal atmospheric content of oxygen is about 21 per cent. When this proportion is reduced by dilution with inert gas below 16 per cent, it will not support combustion; hence the air of a room does not have to be entirely replaced with carbon dioxide to extinguish flame, and air is still respirable when the oxygen content has been reduced to such a point that it will not support combustion, and the danger of suffocation by the users of carbon dioxide for fire extinguishing purposes seems to me to be rather remote.

Carbon dioxide is unusually efficient when extinguishing fires involving flammable liquids, electrical apparatus and equipment, films and delicate fabrics, as the evaporation is complete and no residue of any kind remains. It will not injure the most delicate apparatus. Where fires are confined, such as in the holds of ships or in vaults, we have found the results surprisingly satisfactory. It is a non-conductor of electricity, and may, therefore, be used with safety on any kind of electrical equipment, and unless said equipment has been severely damaged by the fire itself it can be immediately put into service again.

As is well known, there are many fires wherein the extinguishing agent itself causes more damage than the fire has done. This will not be the case with the new extinguisher, and officers will be expected to exercise judgment in this respect, particularly when valuable machinery, goods and merchandise are involved. When using this extinguisher the operator should be very careful not to allow the "snow" or liquid from the discharge to remain in contact with his skin.

We have in the department a piece of equipment known as the "CO_2 Wagon," and the following is a synopsis of its equipment: It is exclusively a carbon dioxide wagon, utilizing liquid carbon dioxide under pressure in steel cylinders. There are two types of units on this wagon, one known as the CO_2 system, which discharges the liquefied carbon dioxide as a gas for fires in buildings inclosed or semi-inclosed. The other unit on this wagon is carbon dioxide extinguishers which discharge the carbon dioxide gas as a snow, which



Carbon dioxide wagon of the Los Angeles Fire Department.

is many times heavier than air, and is a portable type unit for extinguishing fires in the open.

There are eighteen 25-pound size carbon dioxide cylinders in two rows of nine each on each side of the wagon. In the center of the wagon is a sliding rack or container holding six 20-pound size carbon dioxide gas portable extinguishers.

The cylinders each have a separate header or quick release mechanism individually piped or connected to one main header pipe, which is connected

to two 100-foot reels of extra heavy bronze, cloth-covered metallic hose.

Two ½-inch extra heavy brass discharge nozzles, each six feet long, are attached to each hose line and used for discharging the gas.

Each cylinder has a separate check valve and is bracketed with a special cylinder clamp so that empty cylinders can be quickly removed without disturbing the general piping arrangement.

Cylinders refilled at approximately 1000 lb. pressure, room temperature, and sealed with a small metal disc, meeting I.C.C. 3 requirements and Bureau of Explosives regulations. When the sealing disc is punctured the cylinder completely empties in approximately 12 seconds, and a pressure of 600 lbs. per square inch is maintained in the header pipe while discharging.

This wagon is especially designed for fighting fires that require smothering, such as paints, oils, lacquers, electrical equipment, etc.

In this article I have endeavored to confine my comments to facts ascertained from actual experience, and am frank in saying that the department has still a great deal to learn in the most effective use of such facilities now at its command.

In general, our experience thus far has been favorable and encouraging, and I have not the slightest hesitancy in saying that I see no reason why the carbon dioxide system of fire extinguishment should not remain as a permanent feature of our departmental equipment.

Boston Fire Dept. Use of Carbon Dioxide.

By Eugene C. Hultman (Member N.F.P.A.),
Fire Commissioner, City of Boston.

The Boston Fire Department has used portable carbon dioxide extinguishers on a few pieces of apparatus during the past year. This use has been more or less experimental, and the department officers have been requested to make particular note of each fire where these extinguishers have been used. The following summaries of the reports of the deputy chiefs in charge of two divisions where these extinguishers have been used indicate our experience to date.

This does not include any discussion of the theoretical advantages or disadvantages of the type of equipment, as this has been covered elsewhere, nor any comments on the design of the particular equipment used.

Division I.

Carbon dioxide extinguishers carried by Ladder Company No. 8 and Engine Company No. 25 have been used during the year on the following fires:

Ladder Company 8:

February 19, 1929, chimney, 76-78 High Street.
March 11, 1929, chimney, 138 High Street.
April 5, 1929, chimney, 530 Atlantic Avenue.

October 20, 1929, barrel of gasoline, Old Post Office Building.
October 21, 1929, illuminating gas, Old Post Office Building.
November 6, 1929, fuel oil from supply pipe leaking into pit, 258 Franklin Street.
November 29, 1929, chimney, 85 Devonshire Street.
December 2, 1929, gasoline from leaky gas tank, Old Post Office Building.

Engine Company 25:

February 19, 1929, chimney, 76-78 High Street.
November 29, 1929, chimney, 85 Devonshire Street.
November 6, 1929, fuel oil from supply pipe leaking into boiler room pit, 258 Franklin Street.

In all the above cases excellent results were obtained by the use of the extinguishers.

Division II.

The carbon dioxide extinguisher placed on trial on Ladder 13 has been used several times with good success. It has proved a valuable extinguishing appliance for automobile fires. On blazing chimneys, when used from the top of chimney, it has extinguished the fire very quickly, but will not wholly put out a fire in a bed of soot. It has worked favorably on the motors in electric cars.

These extinguishers were used as follows:

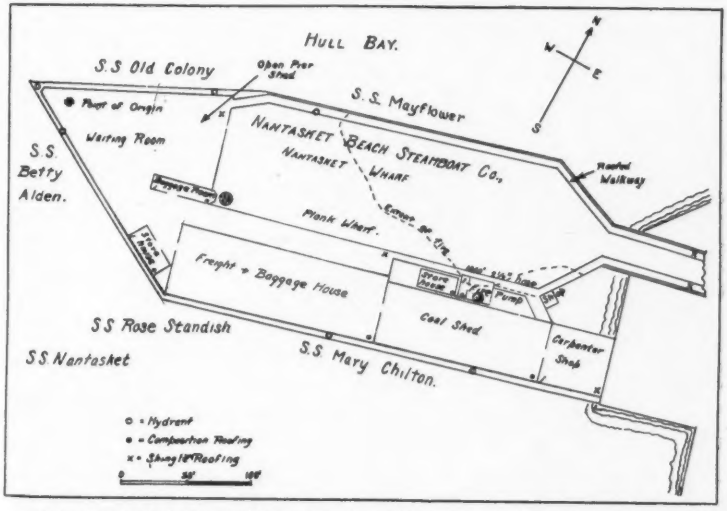
January 4, 1929, box 1561, automobile fire.
January 8, 1929, still alarm, automobile fire.
January 8, 1929, still alarm, chimney fire.
January 12, 1929, Box 2211, fire in grease chute and blower.
January 27, 1929, still alarm in District 3, elevated street car; two extinguishers were used.
February 4, 1929, still alarm, fire in chimney of oil burner.
February 14, 1929, Box 1443, fire in manhole of Edison Co., Summer Street.
April 10, 1929, Box 1538, fire in Elevated Railway bus.
May 19, 1929, Box 1554, fire in oil stove.
June 26, 1929, still alarm, fire in electric light pole.
October 28, 1929, Box 1551, automobile fire.
November 29, 1929, Box 1551, automobile fire.

In all the above fires the working of the extinguisher was very effective, except at the manhole explosion at Box 1443, February 14, 1929, where the proportions were too great for a small appliance to handle.

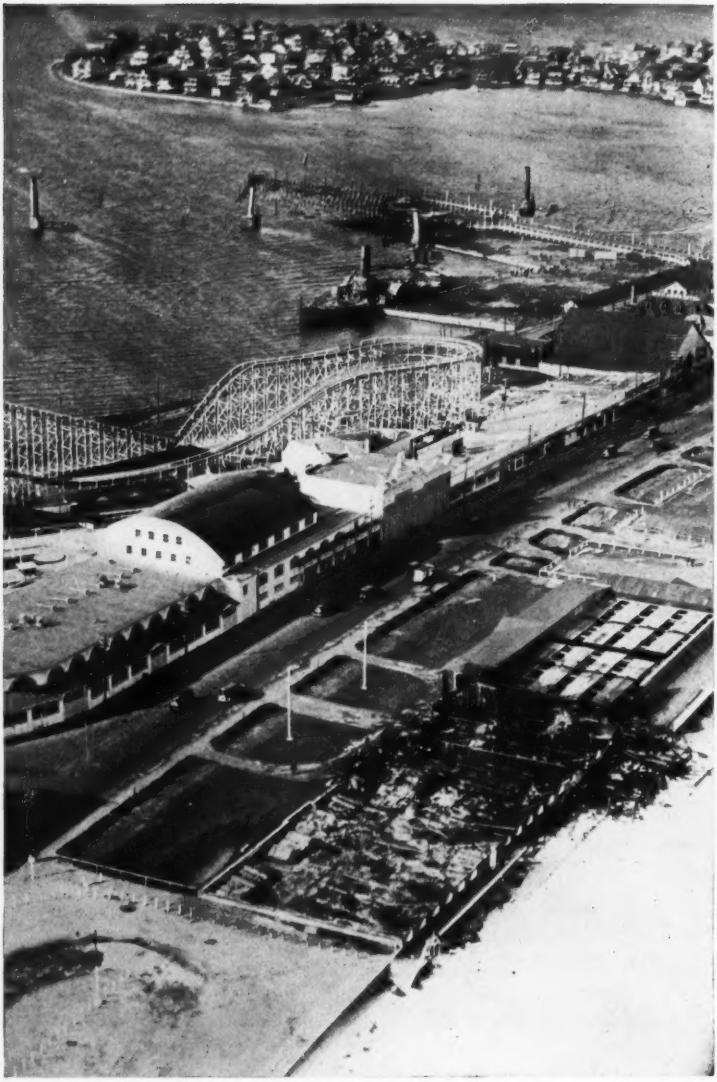
The Nantasket Beach Fire.

Five of the six excursion steamers of the Nantasket Beach Steamboat Co., which for 110 years has carried excursionists between Boston and the beach resort at Hull, Mass., were destroyed in a fire at their pier on Thanksgiving Day, November 28, 1929. A state owned bath house was badly damaged, as were a number of houses in the Atlantic Hill section of the town, which, although half a mile from the scene of the fire, were directly in the path of the embers carried by a strong northwest wind. The total loss was estimated at $750,000, although the replacement figure will be much larger. The cold weather somewhat aided the firemen, as the water from the hose streams froze as it fell, leaving a protective coating of ice on the buildings exposed to the embers.

There were six boats tied up at the pier for the winter when the fire occurred. The captains, first mates, and engineers were required by company regulations to remain with their boats during the winter season. Usually the boats are distributed between two wharfs for winter storage, but this season it is said that all six boats were kept at the Nantasket Beach base because of the severe fire hazards presented by buildings exposing the supply pier at Hull Village, which is at the other end of the town. Steam was constantly



The Nantasket Beach Steamship pier. The six excursion steamers were tied up at approximately the location indicated.



International.

The Nantasket Beach fire of Nov. 28, 1929. In the center background may be seen the ruins of the pier where the fire started, and the wreckage of the five excursion steamers which could not be moved, owing to the low tide. In the foreground are the ruins of the bath house, which was ignited by brands from the burning pier.

kept up in donkey engines on two boats at the end of the pier, attached to dolphins so that in case of a fire they could be drawn away from danger. The positions of these dolphins can be seen in the picture.

The fire was first seen on the northwest peak of the roof of the frame shed which was on the end of the pier. The donkey engine on the *Old Colony* had been fired a few minutes previous to the time the fire was discovered. A spark from this engine could easily have started the fire. Strangers were allowed on the pier for smelt fishing, so that the fire may have been due to a carelessly discarded cigarette in a toilet which was on the pier under the roof where the fire was first seen.

The fire was discovered by an engineer from one of the boats, who immediately called the other employees. One sounded an alarm from the box on the wharf and another started the electric fire pump which took suction from the harbor. The men on duty ran the hose out to a point behind the fire, which, driven by the wind, had already involved the steamer *Betty Alden.* They planned to keep the fire from spreading back against the wind to the other boats and hold the fire in check until the fire department arrived. This stream was in operation only a few minutes when the current in the 2300-volt primary circuits, which ran to transformers at the shore end of the wharf to feed the pump, was cut off. This was done by employees of the Hull Electric Light Department, acting on standing orders from their manager. The loss of water in this hose line from the private fire pump manned by the company employees was the principal factor in the spread of the fire. In shutting off the current supplying the pump, the electrical department protected the firemen from primary wires which ran exposed to the transformer pole on the wharf, but that action resulted in the fire getting beyond control. This made the position of the employees untenable. It is probable that had the chief of the fire deparment been consulted this would not have occurred.

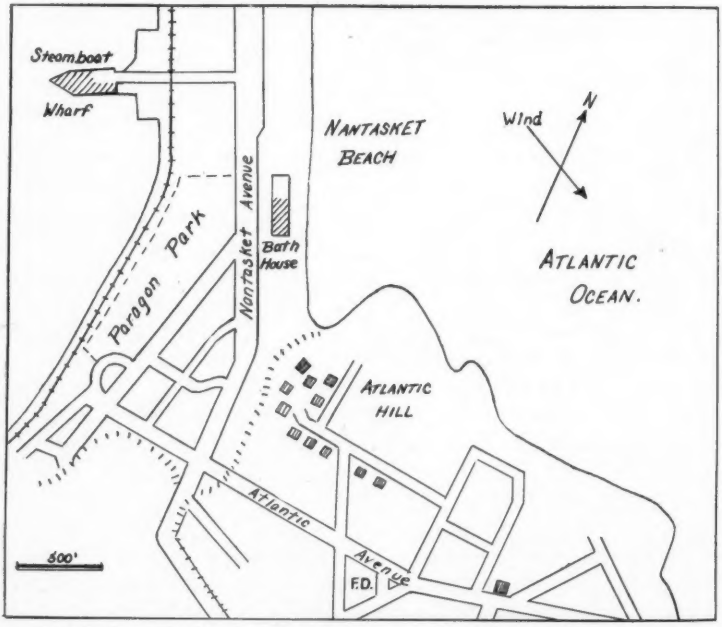
The fire involved almost the entire pier before the fire department could get enough streams in service to check it. The employees were also unable to save their ships by means of the donkey engines, as, owing to the low tide, the vessels could not be pulled out of their basins. This fact also prevented tugs from pulling them to safety. A tug was grounded while trying to pull a steamer away from the wharf. The *Mayflower,* the oldest ship of the line, was the only one saved, as it was the nearest to shore on the north side of the pier. The ships destroyed were the *Old Colony, Nantasket, Betty Alden, Rose Standish,* and the *Mary Chilton.*

The first alarm was received by the fire department at 4:15 P.M., and two engine companies, two chemical companies, and a ladder company responded. The chief quickly sent in a general alarm, which brought two more engine companies, and at 4:30 outside aid was called from the cities and towns on the south shore of Boston Harbor, as well as a fireboat from Boston. The fire departments of Hingham, Cohasset, Weymouth, Scituate, Braintree, Norwell,

and Quincy responded, making a total of fifteen engine and four ladder companies at the fire. The Boston fireboat was considerably delayed in reaching the fire, due to the low tide and the lack of a pilot to take the craft into Hull Bay and Weir River, as the channel is unlighted during the winter.

The first out-of-town fire company to arrive was directed to wet down the buildings in Paragon Park, a large amusement park directly in the path of the embers. Large brands from the coal shed on the wharf set fire to the State Bath House, a frame structure 350 feet long, on the other side of Nantasket Avenue, the main street. More than half of this bath house was destroyed before firemen could get in service at that point. The wooden shingle roofs of several houses on Atlantic Hill had already been ignited by sparks from the original fire, and when the bath house caught fire the buildings on the hill were deluged by embers. The Hull chemical engines did good work there, and a number of the outside companies were also engaged in the fight at that point.

Considering the circumstances, it is remarkable that a large portion of the town was not destroyed by the fire. One fireman was seriously injured when, blinded by smoke, he fell from the roof of the bath house.



Brands from the burning pier at the upper left fell on wooden roofs over a wide area and ignited the other buildings shown shaded in this diagram. But for the efforts of the fire fighters many other buildings would also have caught fire.

Hotel Fires.

The hotel industry ranks ninth in importance in the United States, according to statistics compiled by the American Hotel Association. A recent survey developed the following interesting facts relative to hotels in the United States:

Total number of hotels	25,950
Number of rooms	1,521,000
Number of employees	576,000
Valuation	$5,024,000,000
Annual sales	$1,315,000,000

These figures are indicative of the tremendous growth of the hotel industry, which is well within the realm of "big business." They are further indicative of the great number who daily make their permanent or temporary home under the hotel managers' care, upon whom rests the responsibility for their guests' safety and comfort.

The gravity of this responsibility resting upon those who offer food and lodging to the traveling public is made evident by the losses of life and property indicated by the fire record of hotels as compiled by the N.F.P.A. Department of Fire Record. This record embraces a total of 822 typical fires which have occurred during the past thirty years, and includes both year-round and seasonal hotels.

Hotels are semi-public buildings. Their principal function is to shelter strangers, and thousands of people sleep every night in hotels about which they know very little. A guest registers, goes to his room and retires. He has placed his life in the hands of the manager of the hotel without thought that harm might come to him in the night. The responsibility of the hotel manager is such that any man who realizes what fire can do should hesitate to assume that obligation without first making sure that every possible precaution has been taken to protect his sleeping guests.

That this obligation is to some extent realized is indicated by the advertising of hotels of fire-resistive construction as "fireproof." It is obvious that people are safer in a hotel of fire-resistive construction, but at the same time it must be realized that the use of the word "fireproof" is not a guarantee of safety to the occupants of any building. Combustible contents of fire-resistive buildings make satisfactory fuel for flames, and, as this record will show, fires of considerable magnitude may occur in such structures. Loss of life is often due to suffocation by smoke or the result of panic, particularly in structures where a large number of persons are congregated. Fire-resistive buildings are not immune from possibilities of loss of life from such causes once combustible

contents are ignited. Safety to hotel guests, then, must come from some method which will prevent fire from starting, or if started, keep it from reaching such magnitude that the lives and property of guests will be endangered.

As in the case of schools, hospitals and institutions, the National Fire Protection Association has constantly emphasized the importance of fire safety and has consistently advocated fire-resistive buildings with proper exits, special fire protection for existing buildings, particular care in fire prevention and the various other measures applying. Safety to life in buildings of this occupancy requires: (a) Proper construction of buildings; (b) Adequate exits; (c) Careful housekeeping and protection of fire hazards; (d) A competent, trained staff having adequate personnel on duty at all times.

HOTEL FIRE-SAFETY REQUISITES.

1. **Fire-resistive building construction — complete automatic sprinkler protection for existing buildings of combustible construction.**
2. **Adequate exits—two safe paths of escape always conveniently available from every part of the building.**
3. **Vertical openings protected—all stairways, elevator shafts or other openings through which fire may spread from floor to floor protected by fire-resistive enclosures with fire doors.**
4. **Fire walls to subdivide large floor areas.**
5. **Automatic sprinkler protection for kitchens, basements and other hazardous portions in all cases, and for the entire building where possible.**
6. **Fire alarm facilities for the prompt discovery and reporting of fires, arousing guests, and summoning aid.**
7. **Fire extinguishers and hand hose equipment properly distributed throughout the building.**
8. **Thorough instruction and frequent drills of employees in the proper procedure in case of fire.**

The modern trend in hotel construction represents a distinct improvement in construction over that prevailing a decade or more ago. Many of the more recently built hotel buildings are of first-class fire-resistive construction with adequate fire protection. But there are still a large number of hotels being built in which fire safety has not received sufficient consideration.

Two types of hotels in particular represent severe fire hazards—the old brick building whose walls are of substantial construction, giving the semblance of fire safety, but whose interior is "built to burn," and the frame hotel such as is found at our summer and winter resorts. It is in these two types of structures that the losses of life recorded in this record have for the most part occurred.

The old brick-joist type of hotel is encountered in almost every city. Its interior construction is such as to provide for the rapid spread of fire. The combustible material used in its construction, the large number of concealed

spaces, unprotected vertical openings and flammable contents all contribute to making a hot and quick traveling blaze.

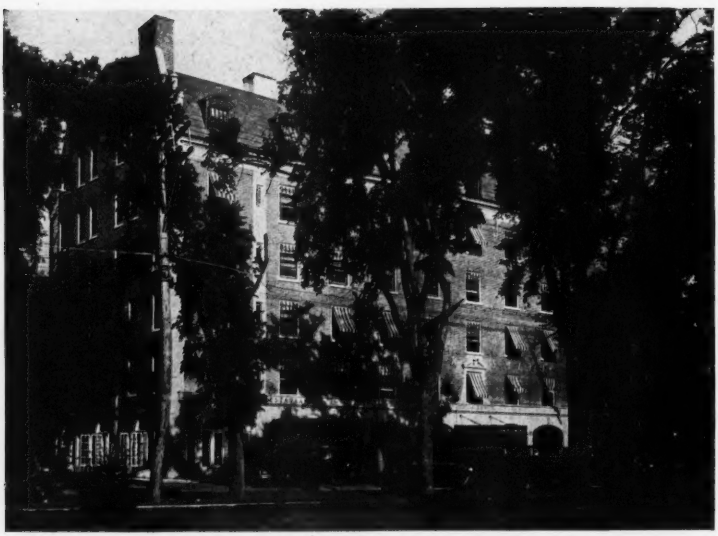
One of the chief reasons for the rapid spread of fire in structures of this kind is the presence of open stairways which start at the main floor and extend through the entire height of the building. These stairways are of combustible material, often highly varnished and carpeted, and are seldom enclosed. They communicate directly on each floor with halls extending the length and breadth of the building. Once fire rises in the stairwell, heat and smoke will travel in all directions on the various floors, not only cutting off escape by familiar means, but spreading fire and destruction to all parts of the building.

Elevator and other shafts also penetrate the building from basement to roof. Often these are open and not cut off at the various floors, thus making perfect flues for fire to extend upward from the basement in such a way as to permit fire to gain considerable headway on upper floors before discovery is made that it has left the basement.

The unsprinklered frame resort hotel represents the worst type of fire trap. The occupancy is heavy, particularly during the summer season. Rambling structures of frame construction make possible a fire of tremendous heat and astonishing rapidity of spread. The comparatively short season during which these structures are occupied does not warrant expensive workmanship. The flimsiest construction is therefore characteristic. Precautions are rarely

Fire Engineering.

What can happen when fire fanned by a strong wind gains headway in a frame hotel. Twenty-five persons were forced to flee for safety from their rooms in the Monterey Hotel at Blue Point, Long Island.



Building Economy.

A modern fire-resistive structure, typical of the newer type of hotels being erected in the smaller cities and towns.

taken to provide any fire stops in the building, or to protect stairways or elevator shafts. During the busy season preventable fire hazards such as accumulated rubbish and other hazards due to carelessness are at their worst, due to congestion and rush of business.

Fire starting late at night in either the old type brick hotel or the frame hotel may quickly involve the basement and then break away, traveling upward with great speed. The limited force on hand in the hotel office at night time makes it almost impossible for the force to warn all guests. It is not surprising, therefore, that loss of life should be heavy in such structures once a fire gains hold.

Ample information is available in the publications of the National Fire Protection Association as to the proper construction and protection of hotel buildings. Anyone who wishes to construct a fire-safe building or to remodel an existing building in the interest of fire safety can readily obtain information as to the best methods to follow. Unfortunately there still are many who have no conception of the seriousness of the fire problem and who must be shown detailed evidence before they can be persuaded to act to safeguard the traveling public in their communities. This detailed evidence, the fire record, is familiar to all those who have made a particular study of this problem. The records of hotel fires assembled on the following pages are not intended as the presentation of new data, but as a compilation of the fire experience in form available for convenient reference.

The material on the general subject of fires in hotels has been subdivided into a number of separate articles: famous hotel fire disasters where major losses of life have occurred or nationally known hostelries have been destroyed; a tabulation and statistical analysis of loss of life in hotel fires; detailed records of typical fires where loss of life has occurred; a comprehensive analysis of fires, including tables of causes, classes of buildings, places of origin of fire and the like, effectiveness of sprinklers, and selected reports of typical fires illustrating points of special interest.

Famous Hotel Fires.

Eight hotel fires of major importance and interest are covered in detail in this section. They include the two memorable New York City fires of some years ago, involving the greatest loss of life in hotel occupancies, and six fires occurring in nationally known institutions in which severe property losses were suffered. These fires, from their national interest, have been selected for more complete treatment than can be given other fires recorded in the following pages.

The Windsor Hotel, New York, March 17, 1899.

This fire is, perhaps, the most memorable fire in hotel history, for it involved the greatest loss of life which has ever occurred in a hotel in this country. Forty-five persons were killed, and this record stands a monument to the tragedy which may be wrought by careless smokers.

The hotel, a seven-story structure, occupied an entire block on Fifth Avenue between Forty-Sixth and Forty-Seventh Streets. It was of ordinary brick and joist construction, with wide halls, high ceilings, and open stairways and elevator shafts. The Windsor was a very high grade hotel and noted for its excellent management. There were 278 guests registered at the time of the fire.

On the seventeenth of March, at about 3 P.M., a guest in a front parlor on the second floor lighted a cigar and threw the still blazing match into the street. As it passed the curtains the latter ignited and in an instant were in flames. Without attempting to extinguish the blaze or give an alarm, the perpetrator of the disaster fled from the room and the hotel.

A few moments afterwards the head waiter, passing the door, found the room in flames. Unaided he made a brave effort to subdue the fire, but it was apparent that more help was needed. The St. Patrick's Day parade was passing at the time. The streets were lined with spectators and guarded by policemen, interested onlookers were leaning out of the windows of the hotel itself, and the strains of many brass bands deadened all other sound. As the head waiter, calling "Fire," ran into the street and endeavored to reach an alarm box, which, unfortunately, was situated on the other side of Fifth Avenue, he

Brown Bros.

The Windsor Hotel Tragedy. A carelessly discarded match brought death to forty-five persons, although the fire occurred in broad daylight in a large city.

was prevented from crossing by a puzzled policeman, who could not understand the excited man's incoherent explanations above the din of the music.

The smoke and flames soon told their own story, and the first alarm was sent in at 3:14 P.M., quickly followed by five additional alarms. Owing to the open construction of the building, the flames ascended with startling rapidity by way of the halls, stairways and in and out of open windows to the top floor. But a few moments elapsed after the first alarm before the entire structure was filled with smoke and flames, and the occupants of the numerous rooms on the several floors were jumping from the windows or imploring help from the multitude that filled the streets below. Aid was accorded as promptly as possible, and the heroism of firemen, policemen and citizens contributed to the saving of many lives.

The first engine company to arrive came from a station only three blocks away. When it arrived people were already jumping from the hotel windows into the street, and from this moment it was evident that the hotel was doomed to destruction. Extra apparatus was summoned and every effort put forth for the saving of life first and the preservation of adjoining buildings next. Both of these objects were successfully accomplished as far as possible, but when count had been taken forty-five persons had lost their lives and a property loss of more than $900,000 had been sustained.

The Windsor had iron ladder fire escapes on two sides and safety ropes in every room, but neither proved adequate means of escape. The latter, in fact, were responsible for several fatalities. Many rescues were made by firemen over aerial ladders and by means of scaling ladders, and at great risk to both firemen and rescued persons. The fire escapes were literally swarming with people descending to the street. Life nets were used on two sides of the building. Some persons jumped into them from as high as the third story and were saved.

In speaking of the rescue work, Chief Bonner of the fire department stated, "I feel certain that no loss of life, by persons jumping from the windows, occurred after the arrival of the department. There was no living person standing at any of the windows while the walls remained standing. The men rescued all whom they saw. No head was shown at a window in vain."

Within a short time a part of the front wall fell, owing to the weight of the heavy water tank on the roof, said to contain 100,000 gallons of water. On the Forty-sixth Street side the walls had fallen completely forty-five minutes after the fire started. At five o'clock the structure was a complete wreck, and a little later the only wall to remain standing slid down to its base like a closing fan.

As a result of this holocaust steps were taken by various authorities to make it impossible for a hotel to burn as the Windsor burned, but it was only three years later that in the same city another hotel fire occurred taking a toll of twenty more lives—and again inferior construction and inadequate exits played their part.

Park Avenue Hotel, New York, February 22, 1902.

In a raging snow storm at 1:30 A.M. a fire broke out in the supposedly fire-resistive armory of the 71st Regiment at Thirty-fourth Street and Park Avenue. Evidently the fire had been burning for some time, and when the fire department entered the building the whole interior burst into flame.

According to the generally accepted theory, burning brands were carried by the stiff gale to the roof of the Park Avenue Hotel at Park Avenue and Thirty-third Street, entered an uncovered shaft, and apparently started two fires at about the same time—one in the upper stories of the hotel and the other at the bottom of the elevator shaft.

The armory had been burning a long time and the guests were watching the conflagration from their bedrooms or gathered in the foyer below, little realizing the danger that menaced them. The proprietor persistently and repeatedly assured those of his guests who were awake of their absolute safety. The others were not aroused until it was too late.

The first intimation of the spread of the fire to the hotel was given when firemen entered the hotel. Revolving doors hampered the stretching of hose lines, making the task more difficult and taking up valuable time. Meanwhile the flames were racing through the structure and the upper floors were all ablaze. The rooms and corridors filled with flame and smoke, and it is probable that many victims were suffocated while seeking to escape. Twenty persons thus lost their lives, while many others were rescued by firemen. The property loss was estimated at more than $100,000.

The hotel was alleged to be "fireproof," and why a thirty-year-old structure having lath and plaster partitions and elevator shafts sheathed with yellow pine should be so advertised was the subject of an investigation by the District Attorney. It is said that it was even without fire-fighting equipment.

The firemen were badly handicapped by the location of the building at the entrance to a new subway and by deep snow, but rendered splendid service in rescuing guests of the hotel by means of ladders when escape by the stairways was cut off.

Hotel Chamberlain, Old Point Comfort, March 7, 1920.

The passing of this famous hotel brought a sense of personal loss to many people throughout the country who had been guests in its hospitable halls. It was one of the best known and most popular hostelries in the country.

The hotel, a brick and frame (mostly frame) structure of from four to six stories, with a water frontage of approximately 700 feet, was built on the government reservation at Fortress Monroe and was about thirty years old. It was not protected by a sprinkler system, but was amply equipped with a standpipe system and powerful pumps, and adequate minor appliances. At the time of the fire it is estimated that five hundred people were in the building,

Hotel Chamberlain, Old Point Comfort, Virginia. All that was left of this famous resort, whose destruction brought a sense of personal loss to its many patrons throughout the country.

all of whom escaped by means of fire escapes, elevators and stairways without loss of life or injury.

The fire started from an unknown cause, possibly defective wiring, at the center of the ceiling of a room at the rear of the main part of the first floor, at 5 P.M. It was discovered when smoke issued from several places. The hotel force attempted to fight the fire for some little time before the fire department was notified, and when the department arrived in response to a telephone call the whole rear of the structure was ablaze and the fire was spreading rapidly through the open partitions and air shafts. There were no fire walls or fire stops in the main building.

Additional help was summoned, but the building was doomed. Sixteen streams were thrown, the motor pumpers and steamers taking suction from the bay. It was only two hours from the time that the alarm was given that the building was completely destroyed. The loss was estimated at $2,500,000.

This was another example of tremendous values being tied up in a tinder-like frame structure. That no loss of life occurred was remarkable, in view of the large number of guests, and was no doubt due to the fact that the fire occurred during the daytime. Had automatic sprinklers been installed the loss might have been nominal.

Arlington Hotel, Hot Springs, Arkansas, April 5, 1923.

Lack of automatic sprinkler equipment was a contributing cause of the destruction of the Arlington Hotel, one of the show places and the largest structure of its kind in Hot Springs. By a fortunate circumstance the fire occurred at 2:40 P.M., when many of the guests were out of the building. As it was, many had narrow escapes and had to be assisted from the building by means of an aerial ladder raised by firemen.

The huge structure occupied approximately three-quarters of an acre and was four stories in height, of brick and frame construction. There were over 300 guests in the hotel when the fire started. The fire had its origin in the basement in the vicinity of the wooden beams under the concrete and tile floor of the café and main hallway. It is supposed that it was caused by defective electric wiring.

At the start it was extremely difficult to get at the fire, for the head room in the basement under the main floor was very slight and it was impossible for a man to stand up and fight the fire. It was necessary, therefore, to cut through the cement and tile floor of the main office to get at the fire. The fire department responded promptly, and at one time, about an hour and a half after the fire started, it looked as though the fire was under control.

The fire, however, spread laterally and then upward through partitions, and by 6:30 P.M. it was obvious that the building was doomed. By 9:30 P.M. the hotel was a complete loss. Shortly after this time one of the walls collapsed, killing a fireman and slightly injuring two others. The fire was confined to the hotel structure, on which the total loss was estimated at $1,000,000.

Imperial Hotel, Narragansett Pier, R. I., Sept. 6, 1923.

Fire occurred in this large frame unprotected hotel, in the attic, at 4:20 A.M. The fire was discovered by a member of the crew of the Coast Guard station, who saw smoke rising from the roof. He summoned the fire department, and additional assistance was immediately summoned from surrounding towns.

P. & A.

Lack of automatic sprinkler protection was a contributing factor in the destruction of the Arlington Hotel at Hot Springs, Arkansas.

Fire Engineering.

This spectacular blaze in the palatial Imperial Hotel at Narragansett Pier started in the attic. The guests consequently were able to escape in safety.

The building was six and a half stories in height, of frame construction with open stairways. It was a high grade, well-managed hotel. The rear part of the basement and a detached laundry building were protected by a dry pipe system of automatic sprinklers, which, however, was not a factor.

On the arrival of the firemen it was seen that there was no chance of saving the structure, but hose lines were run up the main stairway and by this means kept the fire back from the stairs until the guests were all safely out. Shortly after this the roof caved in and the firemen had to retreat.

Flying brands and wooden shingle roofs created a hazardous condition which kept the firemen busy, but with the exception of damage of $5000 to an adjoining frame hotel, little loss was occasioned to other property. The hotel itself was totally destroyed, with a loss estimated at more than $250,000.

Two Hotels "Built-to-Burn," September, 1924.

Gedney Farms, White Plains, N. Y., and Del Monte, Monterey, Calif.

The destruction of two nationally known hotels within a week of each other, situated at opposite ends of the country, and each with a loss estimated at over the million-dollar mark, again clearly demonstrates the fallacy of our "Built-to-burn" construction of resort hotels. There was in many respects a remarkable similarity in these two fires.

Both of the buildings involved were huge, rambling structures, constructed of flimsy combustible material. There are no end of hotels of this

Underwood and Underwood.

Built to burn, this huge, rambling structure was an easy prey to flames. Inadequate water supplies prevented effective fire fighting. Gedney Farms Hotel, White Plains, New York.

description scattered throughout the country, built in the last decade or earlier, with long corridors and open stairways to increase the draft and facilitate the rapid spread of the flames. In both cases, too, the fires occurred at hours when many of the guests were in bed, and these were compelled to flee in scant attire and leave many of their valuables behind them. It is remarkable that in neither fire, in spite of the untimely hour, no loss of life or injury occurred.

The first of the two fires referred to occurred on September 20, at 9 P.M., in the Gedney Farms Hotel, a large stucco and frame structure, just outside the city limits of White Plains, N. Y. The hotel, originally built as a country club, was occupied at the time of the fire by some 150 guests. The fire started in one of the guest rooms, and for several hours was fought and believed to be under control. But lack of water handicapped the fire department and the rambling structure became a mass of flames. Only two weak streams were available and the pressure was inadequate to raise these above the first story. The building was practically destroyed, only a small portion of one wing being saved. The loss was estimated at $1,200,000.

The second fire was in the Hotel Del Monte, at Monterey, California, one of the best known resorts on the Pacific Coast. The fire, of unknown origin, was discovered at 3:15 A.M. on September 27. The manager notified the fire departments of Monterey and Pacific Grove, and summoned his staff of servants and employees, who ran from room to room arousing guests, who rushed out with such clothing and personal effects as they could snatch in their hasty flight.

International.

In two hours from the start of the fire the main section of the famous Del Monte Hotel at Monterey, Calif., was a smouldering ruin. The guests, hastily aroused, escaped in safety.

Half an hour after the fire started the main building was entirely enveloped in flames. Two hours later it was a total loss. The wings of the hotel were saved by the use of dynamite, which tore out the narrow passageways connecting them with the main building. The property loss to the building and contents was estimated at $2,000,000, with an additional loss of $250,000 to personal jewelry and wearing apparel of the guests.

The Breakers, Palm Beach, Florida, March 18, 1925.

This is the story of another combustible seaside hotel which went up in smoke. This time it was a great fashionable hotel, said to be one of the largest wooden structures of its kind in the world. It was a building five stories high, with two large wings and more than 800 rooms.

The fire started at about 4 P.M., when most of the guests were out of their rooms, so that this immense hotel, built of wood throughout and covered with twenty coats of paint, burned to the ground with no loss of life. The fire originated on the top floor of the southern wing, possibly from the careless use of an electric curling iron, and in a few minutes the smoke filled the top floor of that wing. By the time the fire department arrived the wing was a roaring furnace.

The hose was insufficient and the water pressure low. For an hour, to no purpose, the firemen of several towns fought the fire in the central portion of the building, and when they saw that the entire structure was doomed they turned their attention to saving adjacent cottages and near-by buildings.

Over the Beach Club and other frame structures the wind carried blazing embers to the rear of the Palm Beach Hotel, and while the guests and em-

A little thought about fire safety by the user of an electric curling iron and the Breakers at Palm Beach would not have been destroyed.

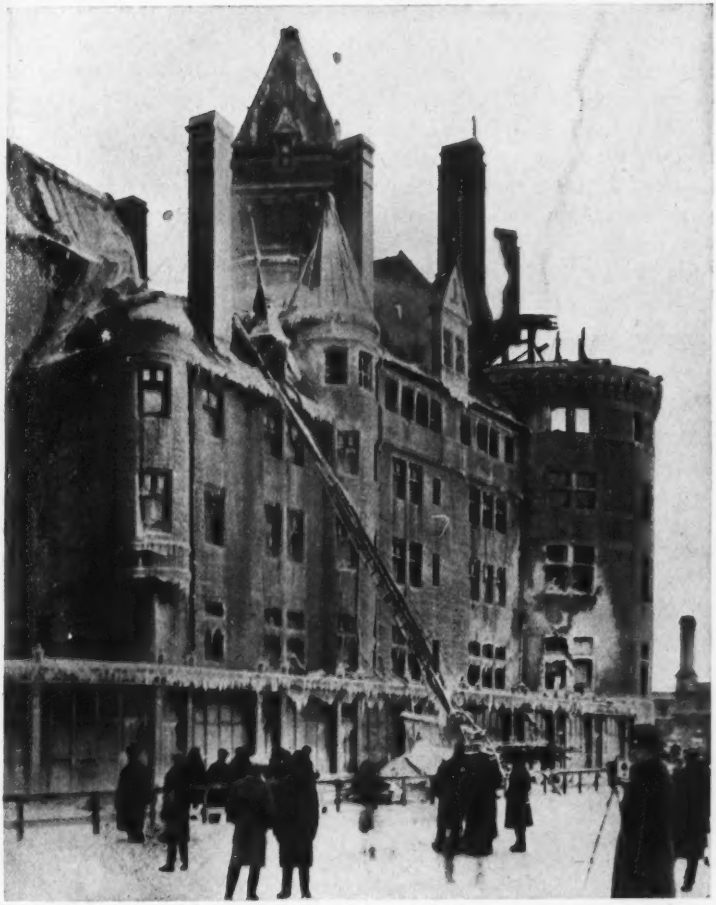
ployees were watching the destruction of the Breakers the flames attacked their own hotel. This fire started at six o'clock, and in an hour this wooden structure of two hundred and fifty rooms was, like its neighbor, reduced to ashes.

The Royal Poinciana, situated about a quarter mile west of the Breakers, owes its preservation to the employees, who formed a bucket brigade and kept the wooden shingle roof wet. A number of shops and cottages were also destroyed, but the fire was brought under control by 9 P.M. The loss to property was estimated at more than $3,000,000, not including loss to the personal belongings of guests.

The Chateau Frontenac, Quebec, January 14, 1926.

A section of the Chateau Frontenac Hotel, Quebec, was destroyed by fire on January 14, 1926, with a loss estimated at between $800,000 and $900,000. The fire was confined to the older section of the building, which was of wooden interior construction, being kept out of the newer fire-resistive portions by rolling steel fire doors which performed their intended function with entire satisfaction.

The burned portion was from five and one-half to six and one-half stories in height, with numerous cupolas and towers. The walls were brick, the floors of heavy joisted construction, the interior finish wooden lath and plaster. This part of the building was subdivided by two fire walls. These, however, stopped short of the roof, and the fire, originating in the upper portion of the building, soon spread from the point of origin through the attic space over the tops of these walls. At the time of the fire the burned portion was not used, being closed for the winter season, all the guests being quartered in the newer fire-resistive portion.



Underwood and Underwood.

Chateau Frontenac, Quebec. This fire demonstrated the value of effective cut-offs between sections of large structures, and the important function of a private water supply.

The fire was discovered about 5:40 P.M. on January 14. The alarm was transmitted from a private box on the fourth floor to the hotel office. The city alarm was immediately given. This was followed by a general alarm at 6 P.M. The exact origin of the fire has not been determined. It started in a room used for the storage of furniture on the fifth floor, spread up into the roof space and from there gradually burned downwards.

With fire doors between fire-resistive and non-fire resistive sections functioning properly, the fire was confined to the latter section. The most effective

work pertaining to extinguishment was accomplished with the private water supply and other fire fighting facilities of the hotel in the hands of the Quebec Fire Department. Valuable service was also rendered by the department by suitably spreading a total of fifty-two waterproof covers.

This fire was of particular interest in demonstrating the value of effective cut-offs between sections of a large structure such as this and the important function of the private water supply system. The municipal protection water works system alone would have been inadequate to supply the water needed during this fire. The private reservoir and the pumps in the basement of the hotel, which supplied a large volume of water, having satisfactory pressure for ten hose streams from standpipes, were instrumental in the extinguishment of the fire.

Loss of Life in Hotel Fires.

In compiling the fire record of hotels printed on page 329, there were found to be one hundred and ten fires in which loss of life occurred. These fires include the well-known hotel holocausts as well as numerous fires in which only a few people were killed. It is by no means a complete list, but includes enough fires to permit generalization as to the factors causing these losses of life. A number of fires are included in which employees, and firemen, rather than guests, were the victims. The list of fires in which lives were lost is as follows:

Windsor Hotel, New York City, March 17, 1899. An elderly guest lighted a cigar and threw the match, as he supposed, out of the window. It lodged instead in a lace curtain, from which the flames quickly spread until the entire hotel was involved. Forty-five persons lost their lives in this fire, due solely to a readily preventable act of gross carelessness.

Park Avenue Hotel, New York, N. Y., Feb. 22, 1902. Fire occurred while fire department were engaged at large fire near by. Revolving doors hampered firemen in getting to work quickly. Twenty lives were lost.

Court View Hotel, Winchester, Ky., Jan. 7, 1909. One guest burned to death.

Farmers' Hotel, Newark, N. Y., Jan. 10, 1909. One employee burned to death and a guest injured by jumping.

Great Northern Hotel, Everett, Wash., Jan. 14, 1909. Two guests burned to death.

Windsor Hotel, Cornwall, Ont., March 23, 1909. Three persons burned to death, others injured.

Kenilworth Inn, near Asheville, N. C., April 14, 1909. A male guest was burned to death.

Central Hotel, Topeka, Kans., April 24, 1909. Four persons burned to death, four others injured.

Ruisseaumont Hotel, Lake Placid, N. Y., July 2, 1909. One employee fatally burned and several guests injured in escaping.

Okanagan Hotel, Vernon, B. C., August 10, 1909. Ten guests burned to death and several others injured.

Central Hotel, Huntington, N. Y., Dec. 8, 1909. Elderly woman burned to death.

Hotel Vance, Utica, N. Y., Dec. 9, 1909. One guest burned to death.

Central Hotel, Oneonta, N. Y., Jan. 16, 1910. One employee and two guests lost their lives.

Hotel Julien, Dubuque, Ia., April 11, 1910. One guest burned to death, several others seriously injured.

Gus Kern Hotel, Newark, Ohio, Jan. 6, 1914. Five men killed, six injured.

Kelliher, Minn., Feb. 4, 1914. Three-story wooden hotel. Fire started in early morning with temperature at 17 degrees below zero. Nine men killed and nine injured. Fire originated around heating plant.

Quincy House, Boston, Mass., March 5, 1914. One man was killed and several were injured. Many had narrow escapes and lost their personal effects. That the results were no worse was due to time of fire, 9:30 P.M. Few guests were in their rooms, and those who were, being awake, got out readily. Cause of fire: careless smoking.

Woodbine Hotel, Toronto, Ont., March 17, 1914. Night fire. Two persons killed, one injured.

Brechin Hotel, Brechin, Ont., March 17, 1914. Three lives lost.

Burton Hotel, Chicago, Ill., Nov. 22, 1915. One life lost.

Seventh Avenue Hotel, Louisville, Ky., Dec. 8, 1915. Two lives were lost and ten persons were injured. Property loss $1500.

Farmers' Inn, Traverse City, Mich., Dec. 31, 1915. Three persons killed.

Connecticut Hotel, Waterbury, Conn., Jan. 4, 1916. One killed and six injured in fire causing a property loss of $100,000.

Hotel Overbrook, Atlantic City, N. J., Feb. 4, 1916. Five persons were killed and five injured in $100,000 blaze.

Windsor Hotel, Santa Clara, N. Y., Aug. 28, 1916. One person was killed and one injured.

Tivoli Hotel, Phoenix, N. Y., Sept. 24, 1916. One person was killed and several injured.

Madison Hotel, Mt. Holly, N. J., Dec. 28, 1916. An explosion of an acetylene lighting plant caused a fire in which two persons lost their lives and five were injured.

Coanahalla Hotel, Hope, B. C., March 6, 1917. Six lives lost.

Stephens Hotel, Creston, W. Va., March 27, 1917. Fire caused by a gas leak cost the lives of three persons and a property loss of $75,000.

Capitol Hotel, Frankfort, Ky., April 5, 1917. Fire originated in beer room in basement at 3 P.M. from undetermined cause. Heavy smoke which filled building coupled with inadequate means of escape cost one life from suffocation. Property loss was $91,000.

Hammond Hotel, Gloversville, N. Y., April 16, 1917. One person was killed.

Willard Hotel, Louisville, Ky., Nov. 7, 1917. A fireman, while rescuing guest on fifth floor, was caught by back-draft and so badly burned that he died next day. A guest and a fireman were injured and only quick action on the part of the fire department prevented greater loss of life. Fire was confined to top floor.

Dempsey Hotel, Macon, Ga., Dec. 24, 1917. Fire occurred in cut-off room in basement of fire-resistive hotel. This room contained a large gas meter and supplies. Heat from fire melted connections to gas meter, causing a second fire and explosion which cost the life of one man who was standing on sidewalk directly over room containing gas meter. Property loss $3894.

Fairview Hotel, Martinez, Calif., Feb. 1, 1918. Four persons were killed and six injured in a fire causing a property loss of $20,000.

Central Hotel, Monaca, Pa., Feb. 4, 1918. One person was killed and two injured. Property loss $20,000.

King Edward Hotel, Halifax, N. S., March 30, 1918. Basement of hotel was being used for storage of war supplies. Fire was caused by explosion of roofing cement being drawn off into metal can. Burning cement filled cellar, trapping employee of relief committee. Property loss $43,000.

Crawford House, Boston, Mass., Feb. 3, 1919. One person was killed. Property loss $35,000.

Palace Hotel, Indianapolis, Ind., Feb. 8, 1919. Two persons lost their lives and eight were injured.

Sydney Hotel, Sydney, N. S., April 28, 1919. One person was killed. Property loss $80,000.

Keeler's Hotel, Albany, N. Y., June 17, 1919. One life was lost in a fire causing a property loss of $500,000.

Empire and Grand Central Hotel, Calgary, Alta., Jan. 18, 1920. Fire occurred at 3:23 A.M. in basement, with temperature at 30 degrees below zero. Of two hundred persons in buildings, three were killed. Twelve firemen were injured, and the loss to property was $150,000.

Elmwood Hotel, East Orange, N. J., Feb. 15, 1920. Fire caused loss of $50,000 and cost one life.

Lorraine Hotel, Providence, R. I., Feb. 18, 1920. Three were killed in a fire which caused a property loss of $80,000.

Lincoln Hotel, Seattle, Wash., April 7, 1920. Two guests lost their lives by jumping from the fifth floor, a restaurant employee was burned to death, and a fireman was crushed by a falling chimney in a fire which destroyed the seven-story brick and frame hotel building. More than two hundred other scantily clad guests made their escape via smoke-filled stairways. Property loss estimated at $400,000.

Elton Court Hotel, Portland, Ore., Aug. 7, 1920. Careless disposal of a cigarette was the cause of a fire which took four lives. The fire spread so rapidly by way of open stairway and elevator shafts that it was impossible for the sixty guests to reach fire escapes or regular exits. Those who escaped did so by way of windows. Property loss $43,000.

Hotel Fort Des Moines, Des Moines, Ia., Aug. 22, 1920. Fire-resistive hotel. Guest in intoxicated condition lost life from burns and suffocation while smoking in bed.

McPherson Hotel, Arkadelphia, Ark., Oct. 18, 1920. Frame hotel. Smoking in bed cost one guest his life and totally destroyed hotel with loss of $23,144.

Boyd Hotel, Hamilton, Texas, Dec. 14, 1920. Two men were killed by falling walls.

Lone Star Hotel, Desdemona, Texas, Jan. 5, 1921. Two persons were killed.

Glace Bay Hotel, Glace Bay, N. S., Jan. 12, 1921. One person was killed in fire which destroyed hotel.

Commercial Hotel, Grandview, Texas, Feb. 14, 1921. A frame hotel was totally destroyed at 3 A.M. by fire of unknown cause. One guest was overcome and lost his life while trying to escape, and another was burned to death in bed. Property loss $7200.

Ohio House, Placerville, Calif., June 26, 1921. Fire started in the kitchen and spread to the hotel and adjacent buildings. One guest was burned to death and another seriously injured.

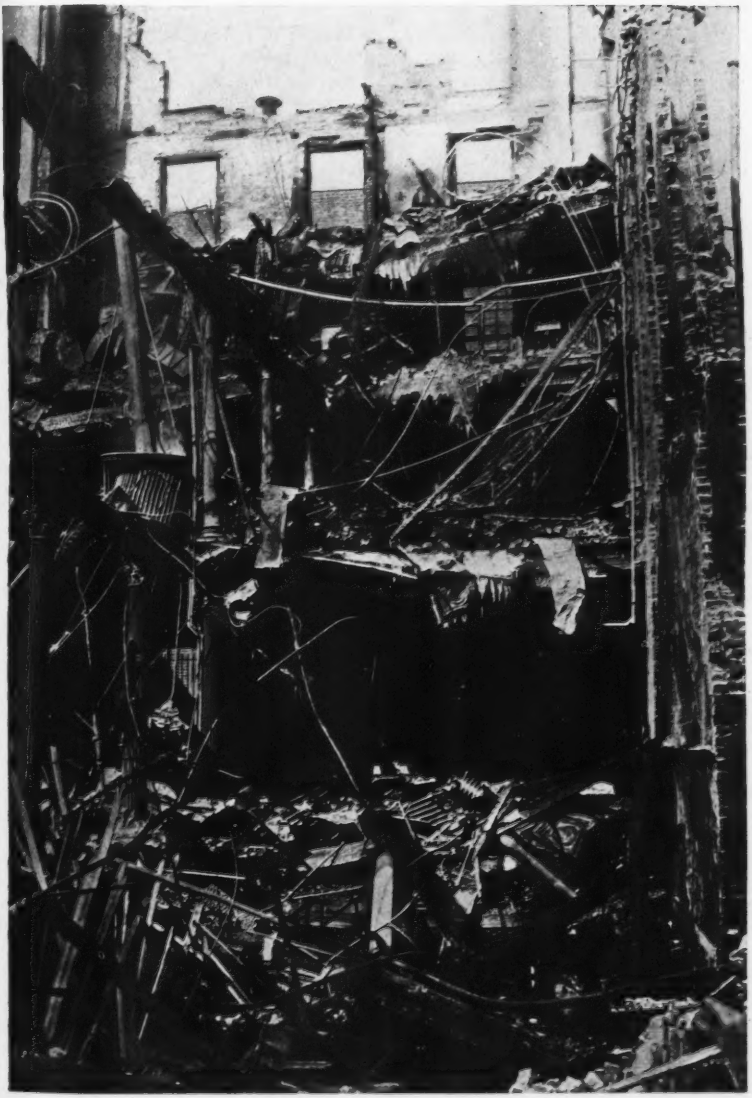
Canoe Inn, Good Ground, N. Y., July 3, 1921. Fireworks were responsible for a fire which caused a loss of $40,000 and took one life.

Beach Hotel, Hyder, B. C., July 23, 1921. One person killed.

Brown House, Macon, Ga., Aug. 22, 1921. Leaking gas in basement was ignited by spark from elevator motor, causing an explosion and fire which took the lives of six guests who were trapped in the blazing structure.

Hotel Lorraine, New York City, Oct. 12, 1921. A painter working in a room on tenth floor was burned to death when varnish he was using ignited from some undetermined cause. Guests tried unsuccessfully to extinguish the flames.

Lexington Hotel, Richmond, Va., Feb. 7, 1922. Delay in sending alarm was a factor in a fire which cost the lives of twelve persons. Seven were killed by jumping and five were burned to death. Spontaneous ignition of oily rags in painter's overalls was cause of fire, which occasioned a loss of more than $250,000.



The Lexington Hotel, Richmond, Va. When this hotel burned, twelve persons lost their lives and many more were injured. Unprotected openings permitted the rapid upward sweep of flames.

Goodrich Hotel, Council Bluffs, Ia., March 3, 1922. A cigarette thrown into painter's material stored under basement stairs was the cause of a fire which spread through the three-story building. One elderly guest was overcome by smoke and died later in a hospital.

Travelers' Inn, Golconda, Ill., Aug. 16, 1922. Smoking on the part of the porter, who was intoxicated, cost him his life and damaged the hotel to the extent of $8100.

Park Hotel, Magnetic Springs, Ohio, Oct. 8, 1922. A hotel employee who lived on the second floor of the laundry building was burned to death and the laundry and hotel destroyed with a loss of $75,000. Careless smoking by the employee is supposed to have been the cause.

Payne Hotel, Weleetka, Okla., Jan. 17, 1923. One man was burned to death in his room in a fire of unknown origin which destroyed this two-story frame structure.

St. Roch Hotel, Quebec, P. Q., March 19, 1923. Cigarette carelessly thrown into corridor caused a fire which gutted upper floors and cost two lives in spite of efforts of fire department.

Hotel Minion, England, Ark., March 28, 1923. Defective wiring was responsible for a fire which cost the life of one guest.

Arlington Hotel, Hot Springs, Ark., April 5, 1923. One fireman was killed and two were injured by falling walls while fighting the fire.

Kineo House, Van Buren, Maine, April 8, 1923. Fire started by an overheated stove on the ground floor of this small hotel cut off escape by stairs and hall. Five of the twenty persons in the building were suffocated or died of burns.

Schmidt Hotel, McKeesport, Pa., July 5, 1923. Three persons were burned to death and one lost his life by jumping and missing the life net. The fire spread so quickly that guests had difficulty in escaping. The single fire escape was cut off by the fire.

Wawa Hotel, Lake of Bays, Muskota, Ont., Aug. 19, 1923. Nine women, six of whom were employees and three guests, lost their lives in this frame summer resort hotel. Inadequate fire escapes and flimsy construction were factors in this loss of life.

Capitol Hotel, Houston, Texas, Dec. 18, 1923. Rapid spread of smoke and flames, coupled with inadequate exits, cost the lives of four guests.

Falmouth Hotel, Portland, Me., Feb. 17, 1924. One woman, age 65, a guest of the hotel, lost her life due to heart failure caused by excitement and smoke. Fire was probably due to defective wiring and occurred in basement of broker's office, which occupied part of street floor of building.

Livingston Hotel, Grand Rapids, Mich., April 1, 1924. Six persons were killed and several seriously injured in attempting to escape from a fire which started in the basement and spread to all floors by way of an elevator shaft. Failure of fire alarm devices delayed warning to guests, and inadequate exit facilities from upper floors caused loss of life.

Hillcrest Hotel, Casco Bay, Maine, Aug. 3, 1924. Three guests lost their lives and a fourth was seriously burned in an endeavor to rescue the others when fire caused by careless disposal of a cigarette swept this frame summer hotel and five adjacent buildings.

Hotel Bothwell, Atlantic City, N. J., Nov. 17, 1924. Two persons were trapped in a fire which started in the kitchen and spread with rapidity to the upper floors. Heroic efforts on the part of the fire department prevented a greater loss of life.

Stamford Inn, Stamford, Tex., Dec. 24, 1924. A mother and two small children were burned to death in a fire of unknown origin which destroyed this stucco and frame hotel on Christmas Eve.

Kendall Hotel, Framingham, Mass., Jan. 26, 1925. One fireman was killed when a floor gave way while fighting a fire. Several other firemen were injured. A woman was also severely hurt when she fell from a rope down which she was sliding in an attempt to escape.

William Penn Hotel, Pittsburgh, Pa., Feb. 6, 1925. The hotel storekeeper was killed and his assistant badly burned in a fire which occurred in the sub-basement of this fire-resistive hotel. The fire originated from an explosion of unknown cause occurring in a quantity of alcohol and turpentine in storage.

Belmont Hotel, Gloucester, Mass., Feb. 23, 1925. Two men were burned to death and nine others barely escaped in a fire of undetermined origin which occurred at 4:30 A.M. The victims were trapped in their rooms in spite of efforts of firemen to reach them. This was the fourth fire that had occurred in this hotel in four years and the eighth since its founding in 1875. In the latter year four lives were lost in a fire which partly destroyed it.

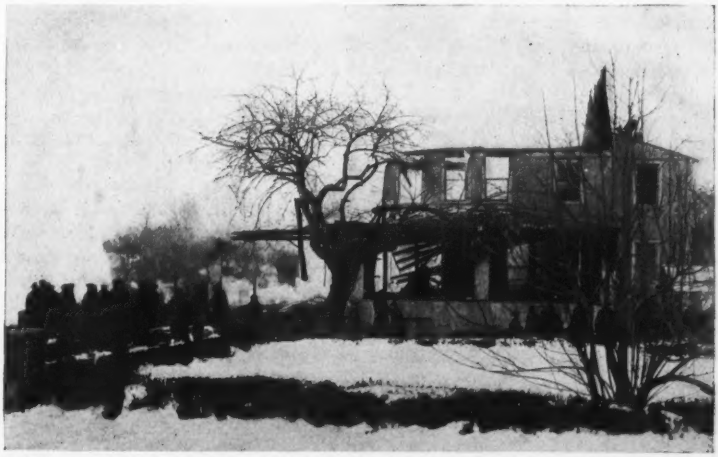
Napture Inn, Quebec, P. Q., July 13, 1925. Two men were killed, one by suffocation in his room and the other in a hospital, from injuries sustained by jumping from a window.

Atlantic Hotel, Long Branch, N. J., Aug. 16, 1925. Two firemen were killed and a sixteen-year-old girl was burned to death when fire destroyed the dining room and servants' quarters. The two firemen were killed by a falling roof, and the girl, a waitress, lost her life when she returned to her room to get her clothing and money.

Ronald Inn, Onset, Mass., Nov. 29, 1925. A fire and explosion in the kitchen cost the life of one employee and severely burned the wife of the proprietor. The employee attempted to change a tube on a gas-pressure device while coffee was being heated. In some manner the gas ignited and exploded.

Johnson Hotel, Farriday, La., Jan. 12, 1926. Trapped on the second floor of a frame hotel, eight men lost their lives. The fire occurred at 3 A.M. in the lower part of the hotel, and survivors state that they were not aware of the fire until the entire structure was ablaze.

Lafayette Hotel, Allentown, Pa., Jan. 23, 1926. Thirteen people lost their lives and five were seriously injured in a fire which broke out at 2:30 A.M. When discovered the two upper floors were involved and house telephone service was crippled, making it difficult to arouse guests. Delay on part of fire department in providing ladders was also a factor in the loss of life.



P. & A.

Eleven guests lost their lives in a fire which started on the third floor of this Hurleyville, N. Y., hotel, which catered to winter sport activities.

Claridge Hotel, Chicago, Ill., Feb. 20, 1926. Guest in an intoxicated condition was burned to death and his roommate seriously burned due to careless disposition of a cigarette.

Arnold Hotel, East St. Louis, Ill., Feb. 20, 1926. Fire starting in the kitchen spread to rooms above. The day clerk was burned to death in his room just above the kitchen, and a guest was burned to death while attempting to escape.

Prairie House, Hurleyville, N. Y., Feb. 22, 1926. Eleven guests lost their lives in a fire which destroyed this hotel, which catered to winter sport activities. Fire apparently started around a chimney on the third floor and spread rapidly through the stucco and frame structure.

Creswell Hotel, Shreveport, La., March 15, 1926. Five guests lost their lives in a fire which destroyed this three-story brick and frame hotel. Many other guests escaped by jumping into life nets.

Meadowside Inn, Mt. Pocono, Pa., March 16, 1926. An employee was burned to death and four persons were seriously injured in a fire which originated on the second floor of the four-story frame hotel.

Hotel Coolidge, Brookline, Mass., June 12, 1926. A guest was fatally burned in her room when she was preparing a cup of coffee by use of "canned" heat. It is presumed that the can upset and ignited her clothing. Hotel employees rushed to her aid, but her burns proved fatal.

Twilight Inn, Haines Falls, N. Y., July 16, 1926. A fire originating in the servants' quarters was beyond control when discovered. The flimsy construction of the hotel contributed to the rapid spread of the flames so that many who escaped only saved their lives by jumping from the windows. Fourteen persons were trapped in their rooms and perished.

Wilson House, Natick, Mass., Feb. 5, 1927. Illicit still in basement exploded, fatally burning one man and seriously injuring two others.

Amarillo Hotel, Amarillo, Texas, March 10, 1927. Fire of unknown origin occurred in the early morning hours in the employees' building. A mother perished when she rushed back into the burning building to rescue her baby. The baby's charred body was found in the ruins.

Svea Hotel, Chicago, Ill., July 20, 1927. Three persons were burned to death and four others were seriously injured in a fire which swept the hotel.

Frankfort Hotel, Cleveland, Ohio, Oct. 16, 1927. A guest was burned to death in his room on the second floor when an explosion of unknown origin transformed the room into a mass of flame. He jumped into a life net held by firemen, but had been so severely burned that he died later in a hospital.

Hotel Oxford, New York City, Nov. 1, 1927. A painter was so badly burned that he died in a fire caused by the ignition of fumes from a volatile varnish remover. Two men were engaged in cleaning the floor, using the varnish remover from an ordinary can as needed. The belief is that the fumes of the varnish remover were ignited by a cigarette, or it may have been possible that a spark was struck by the steel wool they were using.

Buckingham Hotel Annex, St. Louis, Mo., Dec. 5, 1927. Combustible construction, unprotected vertical openings and inadequate exits were responsible for the loss of seven lives in this hotel structure. A hotplate left on was thought to have caused the fire.

St. James Hotel, Decatur, Ill., Dec. 23, 1927. One guest was suffocated by smoke from fire which originated in storeroom of electrical supply company, which occupied first floor of hotel building.

Grand Central Hotel, Hopewell, Va., Dec. 25, 1927. Six persons lost their lives in a fire of undetermined origin.

Westkora Hotel, Ossining, N. Y., Jan. 5, 1928. Two men and a woman perished in a fire which destroyed this century-old hotel. The fire, the fifth in the hotel in six months, was thought to have been of incendiary origin.

Two persons lost their lives when a fire, starting in the kitchen of the Iroquois Hotel in Atlantic City, swept through the structure, cutting off ordinary means of escape. Many persons escaped by jumping from windows.

Central Hotel, Shelby, N. C., Feb. 23, 1928. A fire starting in a linen closet cost the lives of two guests and the hotel clerk. The clerk lost his life by burns while endeavoring to awaken the guests.

Seaside Hotel, Mulgrave, N. S., Feb. 26, 1928. A negro waitress and two negro kitchen maids lost their lives and six persons were severely burned in a fire which started around the chimney in the hotel and spread to six adjoining buildings.

Garrison Inn, Newburyport, Mass., April 2, 1928. An invalid guest of the hotel was burned to death while smoking in bed.

Iroquois Hotel, Atlantic City, N. J., April 15, 1928. Two guests were burned to death in a fire which started in the kitchen of the seven-story brick veneer structure and spread rapidly through the corridors.

Hotel Winton, Jersey City, N. J., April 21, 1928. One man lost his life by suffocation and another was burned to death when an exposure fire from a warehouse adjoining spread to the hotel.

King Hotel, Ennis, Texas, June 4, 1928. Lightning struck this three-story brick hotel at 3:20 A.M. One man was burned to death in the fire which resulted, and another died from injuries received when he jumped to the sidewalk from the third floor.

Baker Manor, Weymouth, Mass., June 15, 1928. An employee lost her life during a fire, being trapped in her room. After the fire was out it was found that she had barricaded the door of her room to keep the flames out and thus prevented rescuers from reaching her. Two others were injured in a 15-foot jump from the second floor to the ground.

Benjamin Franklin Hotel, Saginaw, Mich., Aug. 22, 1928. Four firemen were overcome by smoke while fighting a fire in the hotel and two of them died on the way to the hospital.

Boyle Hotel, Houston, Texas, Dec. 12, 1928. Three guests perished in a fire which swept this 53-room structure. Most of the twenty occupants escaped.

Combs Hotel, Hazard, Ky., Dec. 15, 1928. Five persons lost their lives when they were trapped on the top floor of a five-story brick joist hotel. The blaze, which started in the rear of the first floor, swept up a wooden stairway and quickly enveloped the building.

National Hotel, Minneapolis, Minn., Jan. 20, 1929. Two persons lost their lives by suffocation when trapped in their rooms in this old landmark. Combustible construction aided in the rapid spread of the flames throughout the structure.

Kirkwood Hotel, Des Moines, Ia., April 6, 1929. Another historic hotel of brick exterior but wooden inside claimed the lives of six of its occupants when fire occurred on the upper floors at 2:30 A.M.

Tourist Hotel, Amarillo, Texas, May 11, 1929. Three men were burned to death and two were killed by jumping when flames swept through this old frame structure. The only fire escape was beyond the reach of most of the victims.

The tables which follow summarize the causes of the loss of life rather than the cause of the fire. Thus a fatality due to a fire originating in rubbish in a basement would, depending on the circumstances, be classed as "suffocation while asleep" or "inadequate exits" rather than as due to rubbish. Where direct fire causes are cited as causes of fatalities, this means that the loss of life was due to burns or ignition of clothing by the originating cause of the fire. The tables are thus prepared on an entirely different basis from the usual fire record tables.

In hotel occupancies there have been nineteen serious disasters in which five or more persons lost their lives. As in school and hospital fires, the majority of these losses of life have been due to the lack of adequate or properly arranged exits in combination with inferior construction. In cases where there was more than one exit available the arrangement was often such that the fire cut off both exits. In a large number of fires the loss of life resulted from the fire starting at night while the occupants were asleep.

In considering hotel casualties it was decided to omit from the record all data relative to injuries. In many cases no statement of injuries was made and in others the data were so vague that little would have been gained by an attempt at tabulation.

The following tables are for the most part self-explanatory.

W. E. Patterson.

Before the fire department supplied the ladder shown in this photograph, the fire escape provided for emergency use ended at the second story. Picture the plight of guests rushing down this escape in the night time seeking safety.

Causes of Loss of Life in Hotel Fires.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Construction.	Number of Deaths. Year-Round Hotels	Seasonal Hotels	Total
Fatalities which would have been prevented by superior construction. Cases where loss of life is due to failure to escape from a burning building, whatever the primary cause of fire, are classified under construction.			
Inadequate exits	24	15	39
Attempt to descend, using stairway	22	0	22
Rapid spread of fire cut off exits	69	22	91
Jumped to death from window	33	0	33
Burned to death while asleep	41	0	41
Burned to death—no data as to exact cause	43	3	46
Suffocated while asleep	11	0	11
Total	243	40	283
Burns and Ignition of Clothing.			
Classified in accordance with the direct cause of death, including cases where the victim died of burns, irrespective of whether or not the building was ignited.			
Smoking in bed	6	0	6
Burned by ignition of varnish remover	2	0	2
Burned by explosion of still	1	0	1
Burned by contact with open flame	1	0	1
Explosion of gas pressure device	0	1	1
Total	10	1	11
Fire Fighting, Salvage, and Returning to Burning Building.			
Fatalities resulting from remaining in buildings to fight fires which were beyond control, or from entering burning buildings in ill-advised attempts to save valuables.			
Re-entering burning building	2	1	3
Fire fighting—trapped in building	5	0	5
Fire fighting—falling walls	4	0	4
Trapped while trying to rescue others	3	1	4
Total	14	2	16
Miscellaneous.			
Explosion of acetylene lighting plant	2	0	2
Explosion due to gas leak	4	0	4
Explosion of roofing cement	1	0	1
Explosion of alcohol and turpentine	1	0	1
Heart failure due to excitement	1	0	1
No definite data	42	14	56
Total	51	14	65
Grand Total	318	57	375

Loss of Life—Hotel Fires.

Number of fires in which lives were lost:	
Year-round hotels	96
Seasonal	14
Total	110

	Year-Round Hotels			Seasonal Hotels			All Hotels		
	Guests	Others	Total	Guests	Others	Total	Guests	Others	Total
Men killed	94	25	119	14	6	20	108	31	139
Women killed	20	7	27	13	9	22	33	16	49
Children killed	3	0	3	1	0	1	4	0	4
No data as to sex and age	23	2	25	11	1	12	34	3	37
	140	34	174	39	16	55	179	50	229
No data as to sex, age or status			144			2			146
Total number of lives lost			318			57			375
Loss per fire included in this record									3.4

Typical Loss of Life Fires.

Elton Court Hotel, Portland, Oregon, August 7, 1920.

Four guests were burned to death when fire swept this brick hotel with a loss of approximately $45,000. The fire occurred at 5:01 A.M. and had gained considerable headway when discovered by the proprietor, who had quarters in the basement.

The fire started in a sitting room just off the hall leading to an open stairway and elevator shaft, and is believed to have been caused by the careless disposition of a cigarette or match. Unprotected floor openings, light frame interior construction and particularly the open stairway and elevator shafts were factors in the rapid spread of the fire.

At the time of the fire there were sixty people in the building and the fire spread so rapidly that it was impossible for any of them to reach the fire escapes or exits. All except the four who were burned to death made their escape by way of windows.

Brown Hotel, Macon, Georgia, August 22, 1921.

This building, a four-story ordinary brick-joisted structure, was completely destroyed by fire at 1:15 A.M. At that time an explosion occurred near the elevator shaft which destroyed the roof over the shaft and wrecked the adjacent stairway. The flames quickly spread through the entire building, cutting off the escape of the eighty-nine guests in the hotel.

An alarm was promptly turned in from a fire alarm box in front of the hotel by the night clerk. The first efforts of the fire department on arriving were to rescue the guests from the burning building. Men, women and children were crying for help and some jumped into the arms of firemen and citizens before ladders could be put into place. At the very start, apparently as a result of the explosion, the entire brick wall on one side collapsed, injuring some five or six persons who had escaped by jumping. Six guests were

Underwood and Underwood.

Leaking gas in basement was ignited by a spark from an elevator motor, causing an explosion and fire which took the lives of six guests in this hotel at Macon, Ga. The brick wall on one side collapsed at the very start of the fire.

trapped in the burning structure and their bodies were found when the ruins cooled.

The fire department was unprepared to cope with fires in buildings over three stories high on account of ladders not being long enough to rescue persons above the third floor. The two longest ladders in the department were used, a 45-foot and a 50-foot extension. The 50-foot extension was broken in two by the collapse of the wall.

The cause of the explosion was attributed to a leaking gas pipe from a city main entering the basement. The gas was ignited by a spark from the elevator starter or motor. The leaking gas pipe had been reported to the owners of the building a month previous to the fire, but nothing had been done about it.

Evidence presented at the inquest showed that one of the two stairways in the building had been closed up, and the only stairway left was that behind the elevator shaft, which was demolished by the explosion. Most of the fire escapes were reached through rooms that were occupied, and naturally were locked on the inside—a not unusual condition in many older hotels.

Property loss was placed at $315,000.

Lexington Hotel, Richmond, Va., February 7, 1922.

A fire which broke out at 4 A.M. cost the lives of twelve people and swept through nearly half a city block with a loss of about $250,000.

The hotel, which was built over sixty years ago, was of old style brick and wooden joisted construction. It was located among other old hazardous

International.

The extent of damage caused by the Lexington Hotel fire at Richmond is indicated in the picture. Note the congestion of buildings and the old style of construction.

buildings and was recognized as a serious fire menace by the city authorities. An elevator shaft of wood and metal ran up through the center of the building. There were three fire escapes, two of which were of the stairway and balcony type. The third was simply a vertical iron ladder. There were two open stairways from the lobby floor to the second floor, and from this floor to the third and fourth floors there were three open stairways.

At the time of the fire extensive repairing and painting was being done. The hotel was not closed, however, and guests were in their rooms as usual. The fire apparently started in a small room on the second floor near the elevator shaft. This room was used by the painters, who had left twelve suits of overalls in this room on the night of the fire. It is highly probable that the fire was due to spontaneous ignition in this clothing.

The fire spread rapidly up the elevator shaft and was blazing through the roof at least twenty-five minutes before the alarm was received. The night clerk on duty was old and infirm and apparently became confused and overlooked both the house fire alarm and the city alarm box on the corner. The first alarm was sent in from a box two blocks away by a messenger boy who saw the fire at a distance.

Two ladder companies had been assigned to respond to a first alarm from the box directly in front of the building because of its well-known hazard, but the box from which the alarm was sent had only one ladder company

assigned to it, and the route was down a steep grade not traversed on the route to the box directly in front of the hotel. The delay involved undoubtedly cost several lives.

The first alarm was received at 4:34 A.M., the second alarm at 4:38 A.M. and a general alarm at 4:55 A.M. The fire blazing through the roof and coming out nearly every window on one side. People were jumping from the windows when the firemen arrived. The first company responding to the alarm saw one injured man crawling a half block from the hotel. This company was only two blocks from the fire and was there in less than two minutes after the alarm was sent in. There were twelve lives lost, seven by jumping from the windows, and five by burning. Those that were burned were so badly burned that only the torsos were left, and in two cases the bodies could not be identified. Others that were burned were identified by either their teeth or some article found close to them in the ruins. All of those losing their lives were men. Some were apparently burned in their beds.

A number of thrilling rescues and escapes were made. A woman about seventy years old jumped from the third story of the hotel across a fifteen-foot alley to the top of a two-story building and was rescued from there without being seriously injured. Others came down water conductors. Some came down ropes the painters had on the side of the building. Many escaped by tying sheets together and sliding down to safety. One man was coming down on a sheet from the third floor, when another man caught it and both fell. The firemen caught them in a life net and neither one was seriously hurt. Some jumped from windows when there was a fire escape within three feet of them. The first truck to arrive saved at least thirty persons with its life net and aerial ladder.

It seems probable that the stairs served as flues for the smoke and heat, and were not available. All the stairs did not run from first floor to the top story, but instead two stairs stopped at the second floor where the fire started and it was necessary to walk down a long corridor before reaching the stairs to the first floor.

The fire spread rapidly, badly damaging seven other buildings. It was finally controlled by the excellent work of the fire department.

A special grand jury investigated this fire and, while holding that no evidence was found of criminal violation of the law, declared that there was evidence of gross carelessness, incompetence and a want of proper regard for the safety and lives of guests and employees. They pointed out that the building inspector and the fire prevention board should have had the authority to close the hotel on account of the chaotic conditions due to alterations. The grand jury recommended a new ordinance regulating hotels, with full power given to the fire prevention board to enforce all regulations.

Wawa Hotel, Muskota, Ontario, August 19, 1923.

This was one of the most popular and picturesque hotels in the district. The summer season was at its height and there were 240 guests and employees in the hotel when the fire occurred.

The building was a large two-story frame structure with shingle roof. The interior division walls were of half inch pine covered with burlap. For fire protection a 4-in. main circled the hotel with four hydrants connected to it. The water supply consisted of an 18,000 gallon tank, supplemented by water from the lake pumped by steam pump. Only one hydrant was used, as most of the hose was not accessible at the time of the fire. This hydrant was abandoned on account of the heat shortly after the fire started.

There were 17 inside standpipe connections, but this system was practically out of commission during the fire, as the water supply was shut off at the main valve in the kitchen. There was no organized fire brigade responsible for the maintenance of the fire equipment or for action in case of fire.

The fire started at 12:25 A.M. near or under a hand power hoist in the baggage room. How it started is not known, but it has been established that the shallow pit under the hoist was usually full of rubbish and litter—a fertile field for a carelessly thrown match or cigarette. The fire spread with incredible rapidity throughout the building and but thirty minutes sufficed to see its complete destruction.

Nine women lost their lives in the fire, six of whom were employees occupying rooms in a tower not properly equipped with facilities for escape. Panic and fear may have also been factors in their failure to escape. The property loss was estimated at $325,000.

The Capitol Hotel, Houston, Texas, December 18, 1923.

Four guests lost their lives in a fire which destroyed this hotel and a group of stores with a loss of $147,229.

The building was an old brick structure, entirely of wooden construction in the interior. There had been apparently little or no thought given to fire protection either in the construction or operation of the building. The first floor was taken up with stores and the hotel lobby and the second and third floors were used for sleeping rooms. There was only one central stairway. There were two fire escapes leading from guest rooms, but not accessible to the hallways or to other rooms.

The fire started about 6 A.M. from a short circuit in the electric wiring near the elevator on the third floor and was not discovered until the rear end of the building was seriously involved. The fire spread rapidly through the open hallway and down to the second floor through the open elevator shaft and the adjacent stairway, which was entirely unprotected. The life loss was

Ruins of the Capitol Hotel, Houston, Texas. Four persons were burned to death because of inadequate exits. The fire escape shown in the illustration was not accessible from the hallway.

partly due to persons being overcome by smoke before they were awakened and partly because of inability to reach exits. Most of the occupants of the upper floors were rescued by being carried down ladders. The building burned very rapidly and efforts of the fire department were concentrated on saving lives and protecting adjoining buildings.

The loss of life would probably have been reduced or eliminated if there had been more adequate exits; if, for example, there had been protected stairways at both ends of the hallway, or if fire escapes had been directly accessible from all rooms.

An automatic alarm system might have resulted in the more prompt discovery of the fire and arousing of the guests. Probably the only really satisfactory protection for a building of this kind would have been a complete automatic sprinkler installation.

Livingston Hotel, Grand Rapids, Michigan, April 1, 1924.

Six persons were killed and several seriously injured in attempting to escape from a fire which started in the basement of an old hotel and spread rapidly to the sixth floor through the freight elevator shaft. When the fire was discovered an attempt was made to warn the occupants of the building by the electric fire alarm, but this was found to be out of service. The origin of the fire has not definitely been determined, but it is believed to have started in sweepings, in which there were cigar and cigarette stubs. This refuse was placed near the freight elevator, where there was a quantity of rubbish.

The loss of life occurred because the guests could not escape from the upper floors. On the roof of a lower adjoining building were heard shouts of some of the guests who had jumped from one to three stories. Two women were found lying on the roof and both were lowered through the skylight, one dying later in the hospital. With burning embers falling heavily, an unconscious man was discovered in the light well between the adjoining building and the hotel. He was rushed to the hospital, where he died. Another man was last seen in the hallway near his room on the sixth floor.

A woman, who saved her life by sliding hand over hand down a rope secured to the roof by firemen, reported that her friend was at her side when they were groping through the smoke and that her last recollection concerning her was that she fainted at her side. The body was later discovered among the unidentified ones. The inevitable panic seized three and they were killed by jumping. Two were apparently overcome by smoke and fell back into the flames. One fireman is reported to have been killed.

The building was badly damaged and the contents practically destroyed with a total loss amounting to more than $75,000.

William Penn Hotel, Pittsburgh, Pa., February 6, 1925.

One employee met death and thirty firemen were overcome by fumes while fighting a fire which started from an explosion of a quantity of alcohol and turpentine in a sub-basement storage room. The fire was confined to the area of origin and did damage estimated at $100. Guests in the hotel were not disturbed, the fire being two floors below street level in a building of fire-resistive construction.

When firemen attempted to rescue two employees of the hotel from the fume-ridden room they were overcome and fell back, many of them shrieking and delirious. The whole sixteenth floor of the hotel was converted into an emergency hospital and physicians and nurses called in from hospitals to attend the firemen, who were seized with violent convulsions.

The storekeeper and his assistant were finally brought from the room and taken to the emergency hospital. The former was found to be dead and the latter severely burned.

Lafayette Hotel, Allentown, Pa., January 23, 1926.

Thirteen people lost their lives and five were seriously injured when fire broke out about 2:30 A.M. on the fourth floor of this old stone and brick hotel with frame interior.

The building was erected in 1809 and was originally three stories in height, but was remodeled in 1890 by the addition of two more stories and a rear four-story addition, separated from the main five-story part by a three-story wing. When the two additional floors were added, the old tin roof was left in place; this helped to check the downward spread of the fire.

Means of egress consisted of an open stairway at the center of the main section, another in the four-story rear section, an open elevator adjacent to the main stairway, a fire escape of the usual open iron type with counterbalanced bottom swinging section on the south end of the main building and another on the rear of the four-story section.

For years this hotel was frequented by farmers bringing produce to market, and a stable in the rear provided nest material such as hay, straw, feathers, horsehair, etc., for hundreds of sparrows who lived in the roof and walls of the building. While it was heated from an external community steam heating plant, soft coal was used for cooking purposes. It is thought that a defective flue caused this flammable stuff in the walls and old roof to ignite and that the flames communicated through the upper walls and floors and had been burning for a considerable time before discovery. This would account for the fact that the two upper floors were so thoroughly involved from the first minute and that internal telephone and light wires were burned off. Other possible causes were defective electric wiring, or smoking in bed by a roomer.

Most of the patrons were permanent guests, who made this hotel their home. The night clerk was talking with one of the lodgers, a linotype operator on a local paper who had just come in from work, when they heard outcries above and noticed smoke. They attempted to arouse the 45 guests by using the house telephone switchboard, but could not get in touch with the two upper floors. The clerk started up in the elevator, but was driven back when the car caught fire and he had hardly returned to the third floor when the supports holding the elevators burned away and the car fell to the bottom of the shaft. Brands carried down with it caused the fire to start anew below the fourth floor.

Meanwhile an alarm had been turned in by a taxicab driver and the companies on duty responded. The ladder truck of the Rescue Company became stuck in the car tracks in front of the building when the front wheels were locked crosswise of the body. The only other ladder truck in the city, that of the Hibernia Company, was off night duty for that week. A telephone call to the Hibernias was not explicit and they responded with a hose wagon only. It was then necessary for one of the drivers to call his wife and have

International.

Thirteen persons were killed and five seriously injured in the Lafayette Hotel fire, Allentown, Pa., January 23, 1926. The ladder truck shown in this picture did not arrive until half an hour after the alarm had been given.

her arouse the driver and tillerman of the ladder truck, which finally reached the fire thirty minutes later. This company removed eight lodgers who were hanging from front window ledges on the fourth and fifth floors. Two men jumped, one being killed and the other injured when his fall was broken by the body of the first. Nets were not available and would have been of little use as there was a one-story porch balcony all along the front of the building.

All accounts agree that the flames had gained such headway before they were discovered that the hallways on the fourth and fifth floors were impassable, so that the windows afforded the only means of escape. Smoke alone caused the death of five of the lodgers, who were later found in their rooms unmarked by the flames. Only one man reached a fire escape, while a domestic lost her life within a few feet of it.

With the thermometer at 9°F. the firemen were greatly hampered by ice which formed on the sidewalk, hose, clothing, ladders and walls. Some lodgers reached safety by knotting bed clothes, down which they slid to the balcony roof, whence they were removed by ladders, while others were brought out by hand ladders held at the bottom by firemen and volunteers who had to raise them on their hands in order to reach the upper floor windows.

Whatever the cause, the spread of the flames was aided by flimsy interior wall construction, open stairways and the open elevator shaft. A good sprinkler system might have materially reduced the loss of life. One of the seriously injured was a representative of a well-known sprinkler manufacturer.

The building was a total loss, estimated at $200,000.

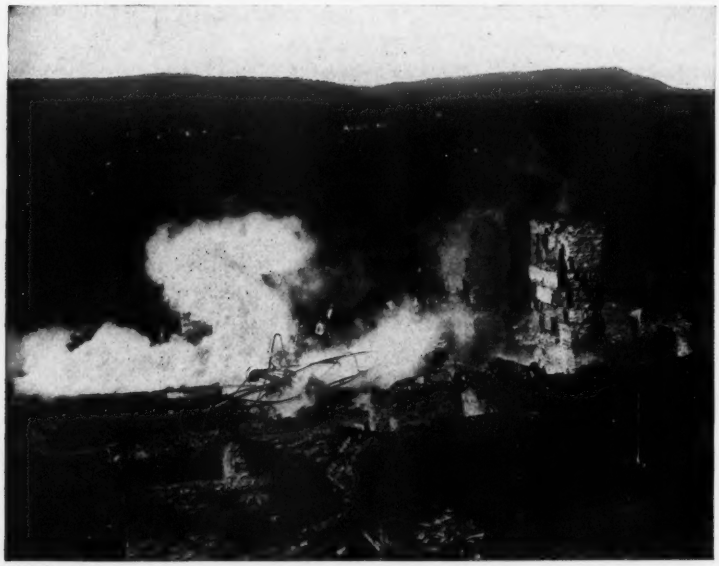
Twilight Inn, Haines Falls, N. Y., July 14, 1926.

After three days of frantic search fourteen bodies were taken from the ruins of this popular resort hotel in the Catskill Mountains. Fire occurred in the early morning hours and in addition to those who lost their lives many were injured in making their escape.

The hotel was a typical three-story frame building. The fire is supposed to have originated on the first floor in the servants' quarters, and was first discovered by the night watchman, who apparently found the fire then beyond control and devoted himself to rousing the guests with the help of other servants. He lost his life doing this, but the occupants of the hotel who escaped probably owe their lives to his alertness. So rapidly did the fire spread that many persons only saved their lives by jumping from the upper windows, thus sustaining severe injuries. The corridors and stairways of the building apparently became impassable early in the fire, and many of the victims were hopelessly trapped in their rooms.

Fire Engineering.

Twilight Inn before the fire which cost the lives of 14 people.



Wide World.

Ruins of the Twilight Inn, Haines Falls, N. Y., where 14 people were killed in a fire which destroyed this Catskill Mountain resort hotel.

Calls were sent to the fire departments in Tannersville and Palenville. The former, three miles away, arrived first, but found the fire so advanced that they devoted their efforts to saving near-by cottages. In this they were successful. Their operations were hampered by lack of water and by the fact that the hotel was situated on an extremely steep slope of a hill. The Tannersville pumper got water from a creek 1600 feet away and 200 feet below the road level.

Newspaper stories said that this was not the first time that a fire had occurred at the Inn, but at each previous time the fire had been extinguished while small.

Buckingham Hotel, Annex, St. Louis, Mo., December 12, 1927.

Combustible construction, unprotected vertical openings and inadequate exits were responsible for the loss of seven lives in this hotel. A number were seriously injured by jumping from windows. Others ran to the street in night clothing or were rescued from their rooms by firemen.

The fire occurred at 3 A.M. while the 118 guests were asleep. The building was a four-story brick ordinary structure with unprotected vertical openings and no fire doors or cut-offs. The fire was discovered by room occupants who smelled smoke and called the hotel office. The night clerk immediately summoned the fire department, who responded without delay.

Fire Engineering.

Combustible construction, unprotected openings and inadequate exits were responsible for the loss of seven lives in the Buckingham Hotel Annex in St. Louis in December, 1927. Note the quantities of flammable materials—the studding, lath, wooden floors, beams and wood roofing.

The fire had apparently been burning for some time, for the building was well involved when the firemen arrived. It is said to have started from an electric hotplate which was left with the current turned on. Of the victims who lost their lives one was suffocated while trying to escape and the others died of injuries received by jumping from third and fourth floor windows.

Property loss was estimated at $295,000.

Fire Record of Hotels.

The files of the Department of Fire Record of the National Fire Protection Association contain reports on eight hundred and twenty-two hotel fires. These have been classified as year-round or seasonal hotels as their occupancy would indicate, there being 510 of the former and 312 of the latter. In compiling this record particular care has been taken to exclude all fires which would more properly fall under the classification of apartments, boarding houses, rooming houses and lodging houses. In so doing, careful check has been made with the Hotel Red Book and other directories to ascertain the status of each building involved in a fire, and the result is believed to be as accurate as possible. The fires recorded have occurred in the past thirty years—from 1899 to date.

The record is by no means complete and does not include many of the small fires which are occurring daily in hotel properties. The reports of insurance inspection organizations, newspaper accounts verified by local N.F.P.A. members and tabulations made from various reports and authentic articles form the bases of the fire record data here presented. The record, in spite of its lack of many small fires, contains a sufficient number of fires large and small of the past decade so that it may be fairly considered as representative and there can be no question as to the validity of conclusions drawn in the tables here.

The extent of hotel fires is shown by figures compiled by the National Board of Fire Underwriters some years ago which indicate that fires occur in hotels at the rate of more than fifteen a day and that the annual loss in hotels in the United States alone averages more than $5,000,000 annually.

The relative frequency of city hotel fires can be determined by the following table which shows the number of fires occurring in hotels in five different cities over a period of ten years.

Number of Hotel Fires.

Year	New York City	Boston	Baltimore	San Francisco	Philadelphia
1918	124	..	17	36	..
1919	95	9	17	73	19
1920	79	13	9	97	18
1921	73	12	6	79	10
1922	76	13	14	82	12
1923	88	12	8	103	13
1924	85	2	10	80	13
1925	105	18	15	68	14
1926	105	11	14	87	19
1927	128	15	10	79	26
1928	..	18	..	..	18
Total, 10 years	958	123	120	784	162
No. Hotels (American Hotel Redbook)	317	55	26	114	37

Similar figures may be obtained for two widely separated states by referring to statistical tables covering causes and losses by fire in hotels in the state of Massachusetts and in British Columbia.

The next tables show the causes of hotel fires, one prepared from N.F.P.A. records, and the others compiled from data furnished by the Department of Public Safety of the State of Massachusetts and the Provincial Fire Marshal of British Columbia. These data, from separate sources, agree with surprising closeness, and based as they are on the analysis of more than fifteen hundred fires would seem to be indicative of the hazards to be guarded against in this occupancy.

Causes of Fires and Places of Origin in Hotels, from N.F.P.A. Fire Record.

	Type Hotel			*Origin of Fire*																			
	Year-Round	Seasonal	Total	Kitchen	Heater or Boiler Rm.	Storerooms	Basements	Elevator, Air Shaft, or Waste Chute	Other Service Dept.	Guest Rooms	Public Halls, Stairways, etc.	Restaurant	Stores, Shops, etc.	Employees' Quarters	Attic or Roof Space	Roof	Out-buildings	Bathroom or Toilet	Laundry, Tailor Shop	Awnings	Outside	Misc.	Unknown
Smoking—Matches	92	24	116	2	1	6	5	9	6	40	7	2	4	3	1	3	1	6	1	7	4	2	6
Defective chimney or flue	16	52	68	7	1	1	0	0	0	0	1	0	0	1	6	2	1	1	1	0	0	5	41
Electrical causes (except small devices)	40	20	60	2	0	5	4	10	0	8	3	4	0	1	7	0	1	0	2	0	0	5	8
Stoves, furnaces, boilers and their pipes	37	21	58	19	15	0	1	0	1	1	5	0	1	1	0	0	2	2	2	0	0	0	8
Ignition of grease on stove or in ventilator	37	2	39	38	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sparks on roofs	7	17	24	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0
Spontaneous ignition—oily material	12	3	15	0	0	6	5	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0
Flammable liquids	12	3	15	4	0	1	1	1	1	3	1	0	1	0	1	0	0	0	1	0	0	0	0
Explosions	8	6	14	3	3	1	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Rubbish and litter	11	2	13	0	0	2	3	3	2	0	0	0	0	1	0	0	0	1	0	0	1	0	0
Electric flatirons and small appliances	7	3	10	1	0	0	0	0	0	5	0	0	0	0	0	0	0	1	3	0	0	0	0
Sparks from stoves, furnaces or fireplaces	8	0	8	3	2	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Oil burners	7	0	7	2	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Defective fireplace	1	4	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	2
Hot ashes	2	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous known causes	12	15	27	2	1	0	2	1	0	2	1	2	0	1	0	0	3	1	0	0	0	0	11
Exposure	19	14	33	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	30	0	0
Incendiary	14	38	52	2	0	0	1	0	3	2	2	0	0	0	0	0	1	0	0	0	4	2	35
Total known causes	342	224	566	85	27	24	27	24	16	64	25	9	6	8	15	30	9	13	10	7	39	15	113
Unknown	168	88	256	18	6	14	26	4	3	13	6	5	9	3	6	2	6	1	3	0	3	31	97
Total	510	312	822	103	33	38	53	28	19	77	31	14	15	11	21	32	15	14	13	7	42	46	210

Causes of Fires in Hotels—State of Massachusetts, 1919-1928 Inclusive.

	No. Fires		No. Fires
Smoking—matches	115	Burning soot in chimney	3
Sparks from chimney	21	Explosion—lamp, lantern or stove	3
Electrical causes	17	Hot ashes	2
Overheated cooking or heating equipment	17	Lightning	2
Defective chimney or flue	17	Malicious mischief	2
Spontaneous ignition	15	Defective oil burner	1
Heating or lighting equipment igniting combustible material	14	Escaping gas ignited	1
Boiling over of fat, etc	11	Fireworks	1
Ignition of grease in ventilator	11	Friction	1
Volatile flammable liquids	11	Mechanic's torch	1
Incendiary	8	Sparks from brush fire	1
Sparks from furnace, stove or fireplace	6	Miscellaneous known causes	4
Defective heating equipment	4	Unknown causes	15
Electric or gas iron	4	Not stated (1921-22-23 causes not classified)	137
		Total	445

Fire Losses in Hotels—Province of British Columbia, Years 1924 to 1928 Inclusive.

Cause	No.	Loss
Smoking—matches	158	$35,552
Sparks from chimney	18	11,738
Exposure	13	82,504
Defective chimney	11	106,279
Stove or stovepipe inadequately protected	7	28,478
Incendiary	6	34,942
Defective wiring	4	13,176
Electrical appliances	4	87
Grease on stove	3	530
Sparks from furnace	3	28,480
Thawing pipes	2	361
Live coals or hot ashes	2	20
Sparks from locomotive	1	43,000
Sparks from stove	1	3,000
Gasoline torch	1	1,741
Lamp upset	1	4,000
Spontaneous ignition	1	29,256
Defective stove	1	6,310
Miscellaneous known causes	8	926
Unknown	18	184,562
Total	263	$614,943

The foregoing tables of fire causes indicate that hotels are not particularly different from other occupancies, as the more common fire hazards head the list. Eight items are responsible for 427 out of 822 fires listed in the N.F.P.A. fire record, or 75% of the fires for which the cause is reasonably well known.

Fire Engineering.

The Profile House fire, August 2, 1923. A carelessly thrown cigarette—a wood shingle roof—inadequate fire protection. Loss $325,000.

Careless smoking and careless use of matches lead all three lists of causes. Smoking among hotel employees can be prevented by rigidly enforced regulations and provision for a place where smoking may be permitted. But in the carelessness of a guest, who flips his cigarette or match into waste baskets or on carpets, or who smokes in bed and dozes off with a lighted cigarette between his fingers, the management has a problem.

Stoves, furnaces, boilers and their pipes, together with defective oil burners and defective chimneys and flues, accounted for 134 fires. An analysis of this group is interesting, as follows:

	Number of Fires		
	Year-Round Hotels	Seasonal Hotels	Total
Defective chimneys and flues	16	52	68
Overheated stove, furnace or pipes	21	10	31
Stove, furnace or pipes too near woodwork	10	7	17
Overflow of oil burner	3	0	3
Back-fire of oil burner	2	0	2
Leaky oil burner	1	0	1
Overflow fuel oil tank	1	0	1
Explosion gasoline stove	1	1	2
Back-fire of gasoline gas generator	0	1	1
Overheated gas heater	1	1	2
Back-fire of gas burner	1	0	1
Overheated oil heater	1	0	1
Oil heater upset	0	1	1
Defective heating plant	1	0	1
Defective stove	1	0	1

Wide World.

Of typical flimsy construction, the Point Breeze Hotel, Nantucket, Mass., was an easy prey to flames which started from an overheated chimney.

Electrical causes, together with electric flatirons and similar small electrical appliances, were responsible for 70 fires. "Defective wiring" as a fire cause is always open to question, and it is possible that in a number of fires in this record in which this cause was assigned there may be some doubt as to the actual cause. An analysis of fires attributed to electrical causes follows:

	Year-Round Hotels	Seasonal Hotels	Total
Defective wiring	29	13	42
Electric flatirons and small appliances	7	3	10
Defective elevator equipment	2	1	3
Defective electrical doughnut cooker	1	0	1
Short circuit—elevator motor	5	0	5
Overheated fan motor	1	0	1
Defective refrigerator motor	1	0	1
Defective hot plate	1	0	1
Defective electrical equipment	0	5	5
Short circuit at switch panel	0	1	1

Grease collecting in the ventilating pipes, connected with the kitchen ranges used in hotels, has frequently caused fire. This grease condenses on the inside of the pipes in a thick coating which may ignite and communicate to near-by combustible material. Such fires are difficult to cope with and are liable to spread rapidly beyond control. Obviously, it is best to forestall fire by frequent cleaning of the ventilators.

	No. Fires
Grease in hood or ventilator ignited	27
Grease boiled over on stove	12

The number of fires on wooden roofs from chimney sparks confirms the already existing evidence that wood shingles are unsuited to use as a roof covering. Many of these fires were in hotels located beyond city limits or in small towns, where a lack of fire protection allowed the complete destruction of the building. City hotels and many hotels of considerable size are ordinarily provided with fire-retardant roofings.

The careless handling and use of volatile flammable liquids was responsible for 15 fires. These fires for the most part occurred in year-round hotels, and in at least four instances caused loss of life.

	No. Fires
Alcohol, used for singeing, upset and ignited	1
Cleaning with gasoline and naphtha	5
Ignition of floor varnish	1
Ignition of varnish remover	2
Gasoline ignited while filling stove	1
Ignition of alcohol and turpentine	3
"Canned" alcohol upset, igniting clothing	1
Gasoline torch ignited barrel of linseed oil	1

Fourteen explosions of various sorts were indicated as causes of hotel fires. The tabulation below gives the exact cause as indicated by the original reports. Eight of them occurred in year-round hotels and six in seasonal occupancies.

	No. Fires
Explosion of compressor (refrigerator)	1
Explosion of roofing cement	1
Leaking gas ignited by spark from elevator motor	1
Explosion of gas in heater	1
Explosion of illicit still	1
Explosion of lantern	2
Explosion of gas in oven	1
Explosion of gas while tube was being changed on pressure device	1
Explosion of hot water heater	1
Explosion of compressed gas in stove	1
Explosion—cause unknown	3

Miscellaneous known causes account for 27 fires. A detailed study of this classification shows these fires to have been largely preventable.

	No. Fires
Sparks from brush or grass fires	4
Careless workmen	4
Firecrackers and fireworks	3
Heating or lighting equipment igniting combustible material	2
Overheated coffee urn	2
Lightning	2
Gas water heat	1
Tar boiling over	1
Acetylene torch	1
Gas ignited by workmen	1
Flame under chafing dish ignited paper decorations	1
Defective ventilator	1
Friction of belt on refrigerator motor	1
Fumigating	1
Spontaneous ignition of hay in barn	1
Spontaneous ignition of soft coal	1

Hotel Fires—Construction and Size.

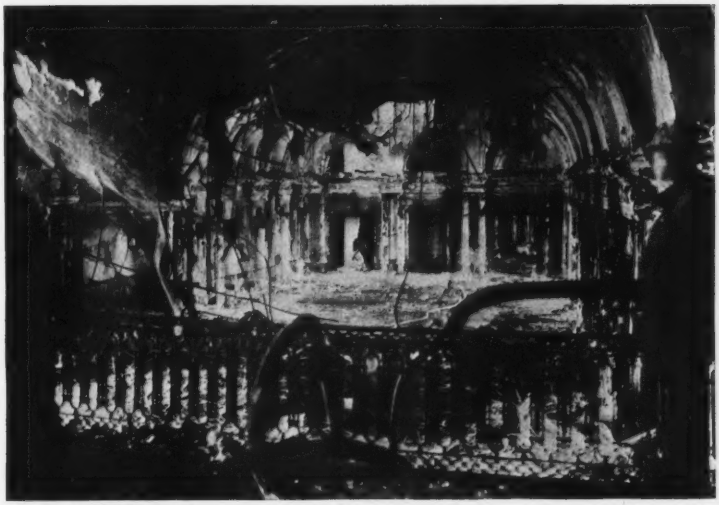
Size.	Fire-Resistive	Brick, Ordinary	Brick and Frame	Frame, Brick Veneer, Stucco	No Data
Year-Round Hotels.					
Less than 25 rooms.....	0	4	3	10	3
25 to 100 rooms.....	0	63	6	34	18
101 to 200 rooms.....	9	44	3	9	9
Over 200 rooms.....	46	59	2	7	8
No data.....	5	72	13	65	18
Total	60	242	27	125	56
Seasonal Hotels.					
Less than 25 rooms.....	0	0	0	1	0
25 to 100 rooms.....	0	2	2	24	4
101 to 200 rooms.....	0	1	2	21	2
Over 200 rooms.....	0	0	0	21	1
No data.....	0	5	1	216	9
Total	0	8	5	283	16

The predominating construction of the year-round hotel buildings involved in the fires recorded is, as the above table shows, "ordinary construction." That is, masonry walls with wooden interior. About half of the buildings in this classification were described as of brick and wood-joist construction—the remainder were described variously as "brick" or "stone," the usual meaning of these terms being that the walls were of brick or stone but that the interior was of ordinary wooden construction. It is possible that some of these were in reality brick-veneered only. It is somewhat less likely, though of course possible, that there may be a few fire-resistive buildings included in this classification. Usually a fire in a fire-resistive building is a sufficient surprise to warrant mention of the type of construction in the report. It may be assumed, therefore, that the majority of these fires were in buildings of combustible construction.

Sixty of the hotels included in this record were fire-resistive. A few were partly so: some had fire-resistive walls, corridors, etc., but otherwise constructed of wood; some had fire-resistive basements only, and a few were fire-resistive except for the roof. It is significant to note that practically all of the fire-resistive structures were buildings of 100 rooms or more, and classified as year-round hotels.

Seasonal hotels were for the most part of frame construction, as were some of the small hotels located in the smaller cities and towns. Many were located in the country or beyond city limits, where restrictions as to construction are very meager or altogether lacking.

The combustible construction was responsible for the complete destruction of many of the buildings in these fires. The combustible wooden interiors, basements not cut off, stairways unenclosed, all contributed to the spread of fire. These fires were difficult to control, even where an efficient fire fighting force was available.



Underwood and Underwood.

A view of the famous ballroom of the Willard Hotel, Washington, D. C., after the fire of April 22, 1922. This is indicative of the damage which may be wrought to combustible contents in a fire-resistive building.

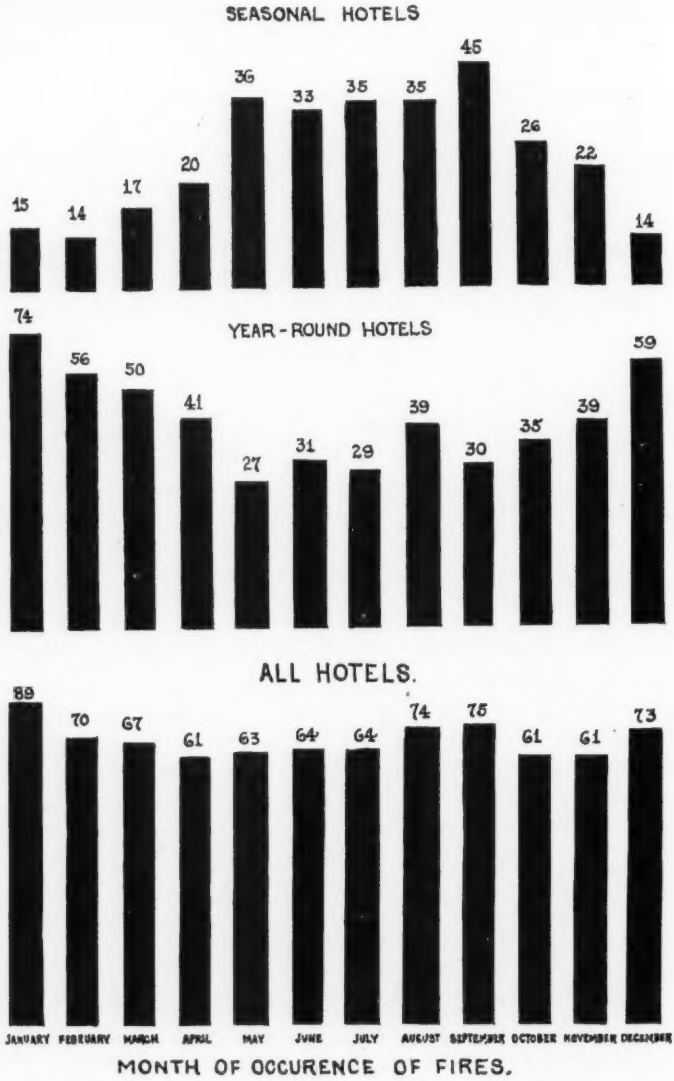
An analysis of the month of occurrence of hotel fires brings out some interesting facts. Fires in year-round hotels were most frequent, as might be expected, in the winter months. Fires due to heating plants and defective flues were predominant during this period.

In seasonal hotels the peak months were the summer months, May and September having the largest number of fires. It is easy to account for the peak of seasonal losses in the summer, for it is then that the greatest number of this type of hotel are in operation and the human element which is back of most fire causes is present. May and September are the months of opening and closing, and fires incidental to these operations and repairing and alterations are to be expected.

In this connection it was interesting to note that fires from incendiary and unknown causes increased noticeably in these two months. This is the result, possibly, of the combination of a poor season and an unscrupulous management.

A brief summary of time of day of fire indicates, for such fires as data were available, that the relative frequency was somewhat greater at night.

Time of Day	Year-Round Hotels	Seasonal Hotels	All Hotels
8 A.M. to 8 P.M. (Day)	81	45	126
8 P.M. to 8 A.M. (Night)	136	38	174
Total	217	83	300


SEASONAL HOTELS
15
14
17
20
36
33
35
35
45
26
22
14
YEAR-ROUND HOTELS
74
56
50
41
27
31
29
39
30
35
39
59
ALL HOTELS.
89
70
67
61
63
64
64
74
75
61
61
73
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
MONTH OF OCCURENCE OF FIRES.

The following analysis of the losses reported shows how large a proportion of the fires in this record were severe losses. This is due partly to the fact that the N.F.P.A. Department of Fire Record does not receive reports on the many inconsequential fires. The generally combustible construction, usual delay in discovery of the fire, and frequent lack of fire protection are reasons why the loss is ordinarily large when a hotel building catches fire. A tabulation of Massachusetts losses over a ten-year period indicates the general trend of hotel losses, large and small.

Analysis of Losses—Hotels.

	Year-Round Hotels			Seasonal Hotels		
	No.	%	Loss	No.	%	Loss
Loss under $1000	53	10.4	$14,094	25	8.0	$7,209
Loss $1000 to $10,000	70	13.7	392,391	88	28.2	464,912
Loss $10,001 to $50,000	113	22.2	3,046,285	87	27.8	2,077,586
Loss $50,001 to $100,000	40	7.9	3,032,044	35	11.2	2,606,582
Loss over $100,000	40	7.9	17,204,509	26	8.4	12,968,381
Total fires—known loss	316	62.1	$23,689,323	261	83.6	$18,124,670
Slight loss	100	19.6		16	5.1	
Considerable	7	1.3		1	.4	
Large	66	12.9		30	9.6	
Loss not stated	21	4.1		4	1.3	
Total fires	510	100.0%		312	100.0%	

Fire Losses in Hotels, 1919 to 1928—State of Massachusetts.

Year	No. of Fires	Loss Bldg.	Loss Cont.	Total Loss
1919	51	$193,955	$100,903	$294,858
1920	32	52,995	14,108	67,103
1921	46	71,024	55,789	126,813
1922	36	67,951	33,608	101,559
1923	55	61,326	23,353	84,679
1924	51	90,060	26,454	116,514
1925	57	293,565	84,141	377,706
1926	45	266,269	58,171	324,440
1927	39	140,238	37,483	177,721
1928	33	65,565	21,535	87,100
Total	445	$1,312,948	$455,545	$1,768,493
Average fires per year				44
Average loss per fire				$3965

Fire Record of Sprinklered Hotels.

This record comprises a total of ninety-eight fires for a period from 1910 through 1928. Of these fires, nine occurred in seasonal hotel property and the remaining eighty-nine were in year-round hotels. Twenty of these fires were of such character and location that no sprinkler heads operated, and in all but one case these fires were reported as having "slight" or "no claim" losses. In this case a large loss was reported, due to fire starting in an attic where there were no sprinklers, and considerable damage was done to the roof.

Of the seventy-eight fires in which sprinklers were a factor, all but two were controlled by the operation of six sprinkler heads or less. In both of the cases which resulted in more than six heads opening, the sprinkler system was not in service for reasons explained in the note following the table. The fire record indicates that sprinkler systems in hotels are well maintained, and there were no instances of failure of sprinklers to extinguish fire with small loss because of lack of care in maintaining the system.

Sprinkler Performance in Hotel Fires (1910-1928).

Number of Fires Reported	Number of Sprinklers Operating	Division of Hotel Property	
		Seasonal	Others
20	0	3	17
53	1	3	50
14	2	1	13
1	3	..	1
4	4	..	4
1	5	..	1
3	6	..	3
96		7	89
2	System not in service.		
98			

NOTE: There were only two fires where more than six sprinklers operated. In both these cases the sprinklers were not in service at time of the fire. In one (a seasonal hotel), the system was shut off for the winter. In the other, sprinklers were just installed and water not turned on.

Discarding the 20 fires where sprinklers were not a factor, and the two fires where water was off the sprinklers, leaves 76 fires upon which to base the following true sprinkler performance table, for hotels completely sprinklered and systems properly maintained.

Proportion of Fires Controlled by

1 Sprinkler or Less	2 Sprinklers or Less	4 Sprinklers or Less	6 Sprinklers or Less
70%	88%	95%	100%

The losses, as indicated by the table below, show that 68% of them were reported as slight, and in addition there were many small losses reported in actual figures. The large losses were one of $100,000 and three others listed merely as "large." The $100,000 fire was the one where fifty heads or more operated. In this particular property the sprinklers were always out of service during cold weather, and the fire occurred during this period. The other three "large" losses were due to (1) no sprinklers where fire started; (2) incendiary; and (3) no sprinklers where fire started. Such losses are naturally not indicative of what may be expected from a complete, properly maintained sprinkler system.

From these data it would appear that hotel fire hazards are such that where sprinklers have been a factor their operations have been 100% successful, and fires occurring have been controlled by the operation of six sprinklers or less. Properly installed and maintained, there is no reason to believe that

such a performance could not be expected in the future from a standard sprinkler system.

Enterprising hotel owners are growing aware of the value of automatic sprinklers in increasing public confidence, and by such installations are not only decreasing the fire hazard, but are making the most of their advertising value. A number of first class hotels advertise their sprinkler systems on their letterheads; others place cards in their guest rooms.

Losses in Sprinklered Hotels.

	No.	Loss
Loss under $1000	21	$5,426
Loss $1000 to $10,000	4	7,669
Loss over $10,000	1	100,000
Total fires, known loss	26	$113,095
Slight loss	67	
Moderate loss	1	
Large loss	3	
No data	1	
Total fires	98	

A typical old style frame resort hotel. This building is protected from internal hazards by a complete installation of automatic sprinklers, and from external hazards by an open sprinkler system on the outside walls and roof.

Fires in Fire-Resistive Hotel Buildings.

The value of fire-resistive construction in hotel buildings has already been pointed out, and the record of fires in such structures is, like hotels equipped with automatic sprinklers, for the most part favorable. At the same time, the fact that of the 60 fires occurring in this type of building more than 10% occasioned a loss estimated as large or as over $10,000, serves as a warning that losses of considerable magnitude are possible even in fire-resistive structures where combustible contents are present.

Loss Analysis—Fire-resistive Hotels.

	No.	Loss
Slight	28	.....
Less than $1000	7	$2,203
$1000 to $10,000	8	50,195
$10,000 to $50,000	4	126,083
Over $50,000	1	66,000
Large	2	.....
No data	10	.....
Total	60	

Of those of more than $10,000 loss, one was $12,083, one $27,000, one $37,000 and one $50,000.

Several examples of fires in hotels of fire-resistive construction are given below. Five of these are typical fires in which fire-resistive construction was a factor in preventing serious loss, and three are fires in which large losses occurred in spite of the excellent building construction. It is an interesting fact that most of the fire-resistive buildings in which fires occurred were also equipped with automatic sprinklers which were a factor in extinguishing the fire.

Typical Fires in Fire-resistive Hotels—Small Loss.

HOTEL CAPE MAY, CAPE MAY, N. J., FEB. 24, 1912. This hotel is an imposing structure of concrete, brick and stone, with fire-resistive partitions throughout, built in 1906. It is eight stories in height and caters to a high class of guests.

Fire occurred when the hotel was closed for the season. Service wires entering the building became crossed with trolley wires, admitting 500 volts of grounded current to the main switchboard. This excess current passed in turn into the entire electrical system, which withstood the strain except at the panelboard on the eighth floor. Here weak and broken-down insulation permitted a flash.

The ensuing fire ignited the wood trim and panel door. These in turn burned away from their fastenings and dropped to the floor, communicating the fire to the wood baseboard and carpet. At this juncture the fire was discovered by the caretaker and extinguished by him with pails of water. Notwithstanding the intense heat caused by the burning insulation, no damage was done to the building except a slight bulging of the partition adjacent to the switchboard.

The loss was confined to the panelboard and wires, the panel trim door, and a small section of baseboard and carpet. It may well be assumed that had this fire occurred in a building of less merit, heavy or total loss would have resulted, with all evidence of cause destroyed.

HOTEL FORT DES MOINES, DES MOINES, IOWA, AUG. 22, 1920. A guest lost his life while smoking in bed. The furnishings of the room, together with the wood trim, were totally destroyed. Only the fire-resistive construction of this hotel prevented the spread of the fire to the corridors and other guests' rooms. Loss was estimated at $1200.

HOTEL ADELPHA, PHILADELPHIA, PA., JAN. 25, 1924. This building is of fire-resistive construction, seventeen stories high. Fire occurred on the top floor in a room used for storage of furniture, mattresses, curtains, etc. Fire was discovered by smoke seeping through to the floor below, and had assumed considerable headway in spite of the fact that employees had been working constantly on the floor.

The fire was attributed to the careless throwing of a cigarette into upholstery. The fire was checked by the use of hotel fire equipment and was confined to a small area, burning stored furniture and other materials and surrounding woodwork. No panic occurred among the guests, and the building itself was but slightly damaged.

HOTEL BRIARCLIFF, BRIARCLIFF MANOR, N. Y., DEC. 24, 1926. The north wing of this hotel is four stories in height and of fire-resistive construction. Although the adjoining frame section of the hotel was equipped with sprinklers, the fire-resistive section was not.

Fire started in a hallway on the fourth floor of the fire-resistive building, near an unprotected doorway to the main section. This portion of the building was used for the temporary storage of furniture, and no apparent cause for the fire can be determined. The fire gained considerable headway and was extinguished with the use of about 15 soda-acid fire extinguishers and a hose stream from the standpipe. One sprinkler in the adjoining building operated and did some water damage, but prevented the fire from entering this section. Considerable damage was done to the stored furniture, but beyond smoking up the walls no damage was done to the building.

HOTEL PROVIDENCE-BILTMORE, PROVIDENCE, R. I., JAN. 20, 1928. A number of firemen were overcome by smoke from a fire occurring in the subcellar of this hotel, a 16-story, fire-resistive building. The damage was confined to a storeroom in which the flames started.

Two alarms were sounded for the fire, which the firemen were unable to reach for some time owing to the heavy smoke. There was no excitement among the guests, and a banquet in the ballroom was not disturbed.

The cause of the fire was undetermined, and the loss was confined to supplies contained in the storeroom.

Typical Fires in Fire-resistive Hotels—Large Loss.

HOTEL LENOX, BOSTON, MASS., FEB. 10, 1917. This hotel is an eleven-story building of fire-resistive construction, 90 feet by 145 feet in area. The surface floors were of wood and were mostly carpeted. The interior trim was of wood, the doors of heavy wood and paneled. There were no transoms over the doors.

The main stairs, located next to the passenger elevator, were open and of iron and marble, with an iron balustrade, the only woodwork being the wooden handrail and the dado moulding. The passenger elevator well was tile-lined on three sides, the front being iron grille-work open on each floor. The service stairs and elevator well, which were used by such of the guests as could reach them on the night of the fire, were well cut off in a brick well.

The fire occurred between 4:30 and 5 A.M., and is attributed to careless smoking. The occupant of a room on the third floor lighted a cigarette and went to his bathroom. On his return he found his bed on fire. The window of the room was open and a strong wind, which was blowing at the time from the northwest, apparently fanned the flame. The outside temperature was about 10° F.

Typical Floor Plan, 2nd to 10th inclusive.

Unable to put the fire out by himself, the guest rushed down to the office to secure the assistance of the clerk and telephone operator, leaving his door open in his haste. The efforts of the clerk and operator also proving unsuccessful, the latter ran back to the office and telephoned an alarm. The fire department has no record of the receipt of this alarm and no apparatus was sent in response to it. At 4:59 A.M. an outsider saw the flames and turned in

an alarm, which was followed by four subsequent alarms. The reason for so large a number of alarms is that men and ladders were needed to save life. This fact was probably also a factor in the spread of the fire, as the firemen were not only busy in the work of rescue, but the service stairs and elevator were in use by fleeing guests, with consequent hindrance to the work of laying hose lines.

The fire rose from floor to floor by means of the main stairs and the passenger elevator well, which it reached from the corridor, along which the flames were driven by the wind. There was little combustible material in the elevator and stair wells, and the fire seems to have spread from heat as much as from flames. The woodwork had a varnish finish which evidently burned readily, blistering where the heat was moderate and bursting into flame and charring where the heat was more intense.

The third floor room in which the fire started was completely gutted, and practically all the woodwork in the path of the fire along the corridor to the stair and elevator wells was destroyed. Fortunately none of the doors were open, and as there were no transoms and the charred doors held, the fire did not communicate to any of the rooms. On this floor, as on the fourth and fifth floors, the fire did not spread more than halfway along the corridor leading from the main stairway to the service stairway.

On the fourth floor the room directly above the point of origin of the fire showed a slight amount of burning at the head of the window, where the fire partially succeeded in gaining entrance from outside. The elevator grillework on the fourth floor was also somewhat distorted as a result of the heat. On the sixth floor the corridor was completely gutted its entire length, and most of the plaster finish had fallen, but fire entered only three rooms.

The fire practically skipped the seventh, eighth and ninth floors, the only damage on those floors being a little blistering and charring of the woodwork opposite the elevator front. Three or four rooms were badly damaged on the eleventh floor, and at the head of the window of one of these rooms occurred practically the only damage to the exterior of the building, the stone trim being badly spalled and the metal cornice above showing some damage. Beyond this the building was apparently not injured structurally, the damage being confined to finish and contents. The loss was estimated at $50,000.

The principal lesson of the fire is that even in buildings of the best construction it is of vital importance to have stairs, elevator wells and indeed all floor openings enclosed in a standard manner. It is of interest to note that the only rooms damaged were those where the doors were open. The absence of transoms was undoubtedly a factor in restricting the loss, as open transoms had there been any, would probably have had the same effect as open doors in spreading the fire.

HOTEL COMMODORE, NEW YORK CITY, Nov. 2, 1927. That a fire of serious proportions can occur in a modern fire-resistive building which is under generally good supervision was demonstrated again by a fire which damaged a portion of an upper floor of this hotel to the extent of $27,000.

This hotel building was erected in 1916-1919 and is of modern fire-resistive construction, covering an area of 57,200 square feet and reaching a height of twenty-six stories, with a roof structure extending three stories higher.

A bank of ten elevators terminates at the first floor of the roof structure and opens into a corridor approximately 100 feet long, 10 feet high and 10 feet wide. This corridor is enclosed by 4-in. hollow tile, the west end leading to the roof of the main building. The east end is protected from the rest of the floor by metal covered self-closing swinging doors. Adjoining the corridor and separated from it by the 4-in. tile partition on the south side, is the hotel valet shop. Two door openings, protected by flat framed iron doors, lead from the valet shop to the corridor, and there are also three small vent openings in the partitioning near the ceiling.

Located inside the corridor were several steel lockers which contained employees' clothing, a large frame cabinet containing employees' and guests' clothing, and on the floor at the west end of the corridor were several rolled up rugs. Some house pipes passed through the corridor near the ceiling, in part protected by insulating covering.

One of the elevator cars was being renovated and had been run to the top of the shaft, where the work of removing the old finish had been started. The small fan in the car was removed and the ends of the electric wires taped. The inside of the car was then coated with a flammable volatile varnish remover applied by hand brush from two small open cans, the supply being replenished as required from a one-gallon can, which was kept near or inside the car.

The work had progressed to the point where practically all of the interior of the car had been coated with the varnish remover and steel wool was being used to take off the old finish. One of the painters was using the steel wool in close proximity to the electrical fan receptacle when a flash occurred and almost instantly the entire car was ablaze. The painters were able to escape from the car, but did not close the elevator doors and the fire extended into the elevator corridor. These men, with other employees, endeavored to extinguish the fire with a 2½-gallon chemical extinguisher and by hand hose from the building standpipe system, but were unable to cope with it.

The hotel fire pump was operated and apparently worked satisfactorily. Upon the arrival of the fire department the blaze had abated considerably. However, connection was made to the standpipe system through a street siamese connection and the fire was finally extinguished by hose streams from the standpipe. It was then discovered that an elbow in the 6-in. standpipe

connection had cracked and the water from the two supply tanks was being discharged into the corridor. An attempt was made to shut off the water, but the gate valve to one tank did not operate properly and could not be completely closed and considerable water continued to flow into the corridor.

The elevator car in which the fire originated was so badly damaged that it had to be replaced, as well as the doors to at least six of the other elevators. The cabinet, lockers, their contents and other combustibles in the elevator corridor were practically destroyed. The corridor had to be almost completely replastered and redecorated, and new doors provided at the west end of the corridor and at the entrances to the valet shop. Some smoke extended into the valet shop but fortunately there was no damage of any amount there. The elevator machinery, located at the top of the shaft, was so separated from the shaft that it was not damaged. Portions of the ceilings in a large number of guests' rooms and in the hallway on the floor below the fire were damaged by water. The water apparently traveled along piping, as ceilings were damaged at points very remote from the vicinity of the fire.

HOTEL SHERMAN, CHICAGO, ILL., APRIL 6, 1929. Another tribute was paid to fire-resistive construction when fire was discovered in a restaurant on the eighth floor of this hotel at 7 A.M. Fire had apparently been smouldering for some time, and it is thought to have been caused by a carelessly thrown cigarette. Due to the construction of the building, the fire was extinguished without even disturbing the guests, although damage amounting to more than $60,000 was done to the furnishings and decorations of the room.

Fires in Which There Was a Loss of Life.

These notes are intended to point out typical conditions under which loss of life has occurred that they may be known and guarded against.

Automobile Accidents.

H-28498. WESTERLY, R. I., Nov. 14, 1929. A truck driver received fatal burns when he was trapped in the cab of his truck after it crashed into two other trucks and caught fire.

H-28501. HAYTI, MO., Nov. 2, 1929. Three members of a family were burned to death as the result of a triple automobile collision. The three cars were traveling in the same direction, and the accident occurred when the rear car struck the middle car, forcing it into the car ahead. All three cars were wrecked and two were overturned. Gasoline from a shattered tank ignited and three occupants of one of the overturned cars were trapped and burned to death.

Chemical Laboratory Fires.

H-28482. OSSINING, N. Y., Nov. 27, 1929. A woman who was making a secret waterproofing compound lost her life when a fire occurred in the laboratory in which she had locked herself while working. A short circuit in an electric cord ignited a pail of powdered paraffine, which was the base of the compound. The burning material scattered in all directions and the woman's clothing was ignited. She received fatal burns before the door could be forced to release her.

H-28493. WORCESTER, MASS., Nov. 20, 1929. A student was making some experiments in a chemical laboratory, when alcohol which he was using ignited from a gas flame. He sustained severe burns which caused his death a week later.

H-28512. ORANGE, N. J., Nov. 6, 1929. One fireman was killed, another fireman and a chemist were seriously burned, and eighteen other firemen suffered from burns and chemical fumes when a chemical experiment transformed a laboratory into a deadly gas chamber. A mixture of diethylene glycol and phthalic anhydride was being heated in a three-gallon proving jar over a Bunsen flame. The mixture became overheated and a slight explosion and fire occurred. The chemist escaped by jumping, although he was seriously burned. The fireman who lost his life was killed by fumes when he entered the laboratory after the fire was practically out.

Clothing Ignited from Gas Stove.

L-492. QUINCY, MASS., Nov. 29, 1929. A woman's clothing was ignited from a gas stove in her apartment and she died in the hospital the next day of the burns received. Other tenants heard her screams and came to her aid, but they were too late to prevent fatal injuries.

Children Playing with Matches.

L-505. LAKE ANDES WAVE, S. D., OCT. 31, 1929. Two little children were burned to death when fire destroyed a barn on the farm where they lived. It is believed that they were playing with matches and set the barn afire. The mother saw the flames and called the father and a brother from the field, but they were too late to save the children.

Clothing Ignited by Cigarette.

H-28494. NEW YORK, N. Y., Nov. 20, 1929. A physician was burned to death when his clothing caught fire from a cigarette as he slumped in his chair due to a heart attack. Employees broke into the suite in the hotel where he lived and found his body surrounded by flames.

H-28489. WASHINGTON, D. C., DEC. 4, 1929. A prominent labor leader died of burns received in a fire in his apartment. The man undoubtedly went to sleep while smoking. He died in a hospital, where he was taken after the fire was discovered by a neighbor.

H-28507. NEW YORK, N. Y., OCT. 16, 1929. A patient being treated in a sanitarium for nervous trouble was fatally burned when his dressing gown caught fire from a cigarette which he was smoking. The man beat at the flames and called an attendant, but by the time the fire was extinguished he had been so severely burned that he died.

H-28508. NEW YORK, N. Y., OCT. 13, 1929. A young man was found burned to death in his hotel room after his clothing had been burned off by a fire started by his cigarette. The man had attempted to extinguish the fire in his clothing with water from the bathroom and failing to do so had returned to bed, his senses benumbed by liquor he had been drinking.

Cleaning with Gasoline.

L-494. CLARKSBURG, W. VA., NOV. 27, 1929. Another was added to the list of victims of the use of gasoline for cleaning purposes when a 27-year-old woman was enveloped in flames and fatally burned as a gallon of the fluid ignited while she was cleaning a dress in her kitchen. A locked door delayed her escape. The house was badly damaged.

Rooming House Fires.

H-28505. SEATTLE, WASH., OCT. 17, 1929. Ten men lost their lives when an old three-story rooming house was damaged by a fire of incendiary origin. Other occupants suffered from burns, smoke and shock. Bodies of seven of the victims were found in various parts of the structure. Some were still in bed and others were near the doors which they had tried to reach. Three other men died of their injuries.

H-28504. NEW YORK, N. Y., OCT. 19, 1929. A careless smoker probably started the rooming house fire which trapped three men on the upper floors. Firemen carried two of them down ladders to safety, but the badly burned body of the third was not discovered until the fire was out.

Re-entering Burning Building.

L-491. MANSONVILLE, P. Q., Nov. 30, 1929. A sixty-year-old man was burned to death in a fire that destroyed his farm home, when he returned to the burning building with the hope of saving a new dress belonging to his daughter.

Kindling Fires with Kerosene.

L-490. SUFFIELD, CONN., DEC. 3, 1929. A woman died of burns she received when an explosion occurred as she was pouring kerosene on wood in a hot stove. With her clothing afire the woman ran to the balcony of her house and jumped into the snow fifteen feet below to extinguish the fire. She was taken to a hospital in Springfield, where she died.

L-495. PHILLIPSBURG, N. J., Nov. 26, 1929. Three children were trapped on the second floor of their home and burned to death when their mother tried to start a fire in the kitchen stove with kerosene. The stairway was cut off by the flames and the parents were unable to arouse three children in a room directly over the kitchen. Four other children were rescued from the front of the building and one escaped by jumping. Last year the same family lost one child, who was burned to death while trying to kindle a stove fire in the same manner.

L-499. MILLERTON, N. Y., Nov. 13, 1929. A woman was fatally burned and her five-year-old son was very seriously burned when she attempted to start a fire with kerosene.

L-506. MOBRIDGE, MASS., Nov. 5, 1929. An attempt on the part of a man to revive a fire in a stove by pouring kerosene on the open fire resulted in his death. He was pouring the kerosene from an open can on to the coal fire in a barber shop. An explosion occurred and almost every part of the man's body was burned.

Gasoline Tank Explosion.

H-28506. NORTHAMPTON, MASS., OCT. 16, 1929. A spark from an unknown source ignited the fumes from an empty 20,000-gallon gasoline tank, causing an explosion which fatally injured one employee and which blew the tank high in the air. The tank had been taken from the ground for repairs. Three other men were treated for burns.

Gasoline Ignited by Heater.

L-508. DEADWOOD, S. D., Nov. 19, 1929. An infant was fatally burned in a gasoline explosion and fire which occurred when he knocked over a can of gasoline while playing. The gasoline fumes were ignited by a gas heater in the room.

Child Overcome by Smoke.

L-496. BARRE, VT., Nov. 25, 1929. A little boy was overcome by smoke and died when a fire occurred in the basement of his home. When the fire broke out his mother was unable to find the child, who was later located in a closet, nearly suffocated. He was rushed to a hospital, where he died.

Trapped in Workmen's Quarters.

H-28497. PERKINS GROVE, N. Y., Nov. 15, 1929. Two men burned to death and several others were seriously burned when two cars used as bunk-houses on a railroad construction job were destroyed by fire. Shortly after twenty-one workers had entered the bunk house for the night, two men started to fill a lantern with gasoline. The lantern was held near the stove, which ignited the gasoline as it overflowed the lantern. Almost the whole interior of the car was immediately involved in flames. The only door was cut off and there was but one small window at the other end of the car. The fire reached several of the men before they could be pulled through the window by those outside.

H-28480. NEW YORK, N. Y., Nov. 25, 1929. Two men were killed and twenty-two injured when fire started on the first floor of a two-story concrete and iron-clad building, housing subway workers. Just before midnight, while 200 employees were on the second floor putting on their work clothes, a short circuit occurred at a large switch on the first floor and started a fire. There were but two very inadequate stairways leading to the first floor and but one door to the building. There was a panic when the fire was discovered and most of the men rushed to the stairways, where some fell down and a number were injured. Others squeezed through the small second floor windows and jumped to the ground. Despite the fact that there was little wood in its construction, the fire spread rapidly through the building. The bodies of the two men killed were found in the wreckage.

Kerosene Stove Explosion.

H-28490. NEW YORK, N. Y., Nov. 4, 1929. An attempt by a nurse to refill a small kerosene stove from which the wick was still smoldering, resulted in an explosion which caused her death and severe burns to a new born baby. When the explosion occurred the nurse took the child into another room and then returned to fight the fire, which then ignited her clothing. The mother managed to take her infant to a window, where she collapsed. Outsiders took the family, including several other children, to safety.

Defective Oil Heater.

L-498. FRANKLIN, N. H., Nov. 21, 1929. A two-year-old child was fatally burned and his mother and two little sisters were seriously burned when a bottle connected with an oil heater broke and released oil which ignited from the stove. The three children and their mother were asleep when the fire occurred. The father was burned when he came in to save them.

National Fire Protection Association

INTERNATIONAL

Executive Office: 60 Batterymarch St., Boston, Mass.

The National Fire Protection Association was organized in 1895 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects and to secure the coöperation of its members in establishing proper safeguards against loss of life and property by fire. Its membership includes over a hundred national and regional societies and associations and more than four thousand individuals, corporations, and organizations.

The QUARTERLY is one of a large number of publications issued by the Association and sent to the members as published. These include the monthly *News Letter,* standard regulations on fire prevention and fire protection, special reports and bulletins, the Year Book, and the Proceedings of the annual meetings.

Membership in the National Fire Protection Association is open to any Society, Corporation, Firm or Individual interested in the protection of life or property against loss by fire. All the valuable engineering and popular literature issued by the Association is sent, as issued, to every member. The Association is the clearing house for all the authoritative information on Fire Protection and Prevention, and members are privileged to submit to it their individual problems for solution. The Association is always glad to send samples of its publications to prospective members upon request.